ELECTRICAL REVIEW

[ILLUSTRATED]

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

(Formerly Review of Telegraph and Telephone)

Vol. 5, No. 20. WEEKLY. | NEW YORK, SATURDAY, JANUARY 17, 1885. | $3 per annum. Single Copies, 10 Cents.

Copyright, 1883, by ELECTRICAL REVIEW PUBLISHING COMPANY, 23 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

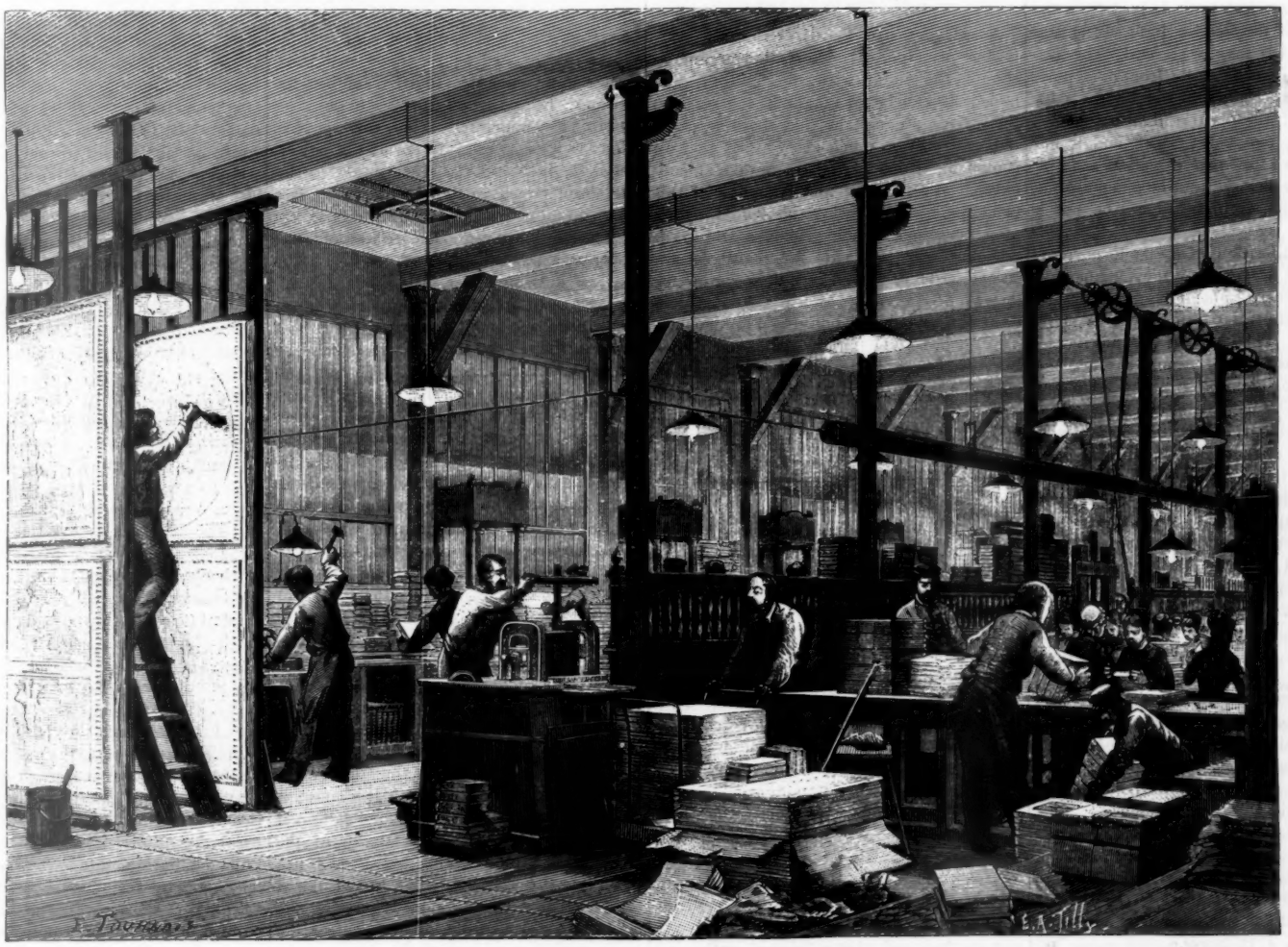
The Electric Light in the Publishing House of Messrs. Hachette, Paris.

The great workshops of the *Librarie Hachette*, Rue Stanislas, in Paris, says *La Lumiere Electrique*, are now completely equipped with the electric light. The importance of this installation, comprising about 400 incandescent lamps, as well as the precautions taken to secure a perfectly regular service, appears to us to deserve some notice. The manager of the workshops had introduced about 80 Edison incandescent lamps about two years ago, and the results obtained were so satisfactory that in September last the Messrs. Hachette decided to renounce gas entirely, and to install a complete and general electric lighting system. The new system, which was finished in five weeks, comprises one dynamo of 200 lamps and two of 6 lamps. The two latter are driven by the engine furnishing the motive power of the building, having a nominal force of 50 horse-power. The other (200 lamp) dynamo is driven by a relief engine of 25 horse-power, especially adapted to electric lighting, and capable, in case of accident to the principal motor, of driving the shafting of the workshops and the three dynamos. The boiler of this engine is always under pressure during the day, for the purpose of heating the drying rooms and the workshops by steam, and at the moment for lighting up the steam is directed through the motor, which can thus be put in operation in a few minutes. In this manner the electrical machines are driven by independent motors, preventing a general extinction in case of accident to one of the motors; and, in addition, a simple system of distribution enables the attendant to direct the current of any machine through any portion of the shops.

The distributing system consists generally of three switchboards, provided with fusible safety plugs, permitting a variety of combinations of grouping. Each field magnet is provided with a rheostat for regulating the strength of the current in the magnet, and each machine has a Carpentier voltmeter connected directly to the collecting brushes. There are also ten lamps placed near the dynamos, serving as standards of the lights furnished to each shop. This apparatus, with the dynamos, is all placed within the easy reach and control of one person, who can thus regulate the luminous intensity of each branch of the service without leaving his place. The switchboards permit of running all of the groups of circuits from one dynamo, or of running them all from the three dynamos connected in quantity, or in the normal manner of one group from each dynamo. Our illustration, showing one of the workshops on the first floor, gives a very clear idea of the manner in which the lights have been distributed.

Generally the lamps are attached to wooden rods, having a groove to contain the wires; or else they are attached directly to the ceiling in special skylights. All the wires are hidden behind wooden mouldings, thus ensuring insulation as well as protection from injury. The Edison 60-lamp dynamos are of the type in use and exhibited at the time of the Paris Exposition in 1881. As to the 200-lamp machine, it is of new model, being part of a series recently constructed at the company's factory at Ivry. This machine gives a current of 150 amperes, with a tension of 120 volts, at a speed of 1,300 revolutions per minute. The internal resistance of the armature is only 0.023 ohms.

Although it will be impossible to give exact details of the cost price of this lighting until after a year of use has elapsed, we can say, meanwhile, that at the present time the saving actually realized over the cost of gas is 30 francs ($6) per night.



THE ELECTRIC LIGHT IN THE PUBLISHING HOUSE OF MESSRS. HACHETTE, PARIS.

Articles of incorporation of an electric railroad, to run from Far Rockaway to the Long Island Railroad, have been filed in the Queen's County clerk's office at Brooklyn. The capital is $200,000.

Lessons Taught by the Philadelphia Electric Exhibition.

The people of the United States have had their first great electric exhibition, and it has been a success, not only in educating the American public as to the advance achieved by this great industry, but also, we may hope, in further stimulating the inventive genius of the electrical engineers and scientists of that home *par excellence* of the inventor. That with these advantages is combined a favorable financial result (the Franklin Institute having a handsome balance of over $10,000 at its disposal), is a feature which does not generally apply to electrical exhibitions, and on which the managers may well be congratulated. It is all the more satisfactory, as the purely financial aspect of the exhibition had not been too strongly considered at the first start off, although the hope was entertained that the receipts would cover the expenditure.

While awaiting the reports from the various examining committees as to the respective merits of the different exhibits brought to their notice, opportunity is afforded to review some of the impressions created by the exhibition. Although its title indicated that it was designed to be "International" in character, there was a general feeling of disappointment that there was so little claim

to such a designation. This was not, however, in any respect the fault of the management, but rather the natural result of the protective policy which prevails in the United States, the avowed object of which is to discourage and prevent foreign competition. It is the hope of deriving a profit from an increased sale of their wares, that leads manufacturers to incur the expense of making a display, and this commercial feature was doubtless very prominent in the case of the American exhibition. The only foreign electrical goods which may be said to find a market in the States are instruments of measurement, and philosophical apparatus, and these constitute all the British or Continental exhibits of importance that were displayed. The great feature of the exhibition was the electric light display, and to many Americans who have been familiar with but one or two systems, the number of complete plants of arc or incandescent lamps and dynamos presented for competition, must have been a surprise; although in the general introduction of the electric light our American cousins are, as was so conclusively shown by Mr. W. H. Preece in the interesting paper to which we recently referred, immeasurably before us. Practically the electric lighting business is in the States as open to competition as the manufacture of steam engines. Certain appliances ear, of course covered by patents, but there is little promise of fabulous wealth to be derived from the introduction of the electric light, excepting when a monopoly may be secured. The sanguine hopes of such results from monopoly, which were entertained in our own country at the time of the electric lighting mania, have also long ago faded away, and it appears to us high time that litigation as to infringements of electric lighting patents, often based on slender grounds, should be put a stop to.

It is the utilization of dynamic currents which has led to the recent development in electric machinery, but it is generally believed that still greater strides will be made in the future. This, however, is not necessarily the case. The steam engine, the Morse telegraph and the speaking telephone were practically complete inventions, and their improvement has been principally in the perfection of their manufacture, the skill with which they are handled, and their more economical application, rather than in any radical improvement in their construction. The Morse operator of to-day could obtain as good results with the instruments used forty years ago, as he can from the modern key and sounder.

The Davenport motor of 1837, a model of which was in the Patent Office collection, has not been greatly improved upon. It successfully drove a printing press 25 years ago, and is unquestionably superior to many which have followed it, and which have absorbed thousands of dollars from the coffers of enthusiastic investors who have expected to see electricity supersede steam. The popular ignorance upon this subject was demonstrated at the American Exhibition by the inquiry of a visitor from Ohio, an apparently intelligent manufacturer, who desired to obtain a dynamo of sufficient power to drive a 15 horse-power steam engine. Further inquiry brought out the fact that he supposed the function of a dynamo was to generate power within itself, sufficient to drive an engine, thus dispensing with the steam boiler and the consequent consumption of coal.

If the exhibition, with its concurrent circulation of electrical primers has corrected any of these false impressions of the wonders of electricity, it has certainly proved its usefulness. Our own electric exhibitions have done much in this direction, although, with some show of reason, the reproach has been fastened on them—and especially the Crystal Palace Exhibition—that they have too exclusively served commercial aims.—*Invention.*

The Metric System.

Attention is called to the following remarks by Sir William Thomson during an address at Philadelphia last summer: "You in this country are subjected to the British insularity in weights and measures; you use the foot and inch and yard. I am obliged to use that system; but I apologize to you for doing so, because it is so inconvenient; and I hope all Americans will do everything in their power to introduce the French metrical system. I hope the evil action performed by an English minister, whose name I need not mention, because I do not wish to throw obloquy on any one, may be remedied. He abrogated a useful rule which for a short time was followed, and which I hope will soon be again enjoined, that the French metrical system be taught in all our national schools. I do not know how it is in America. The school system seems to be very admirable, and I hope the teaching of the metrical system will not be let slip in the American schools any more than the use of the globes. I say this seriously. I do not think any one knows how seriously I speak of it. I look upon our English system as a wickedly brain-destroying piece of bondage under which we suffer. The reason why we continue to use it is the imaginary difficulty of making a change, and nothing else; but I do not think in America that any such difficulty should stand in the way of adopting so splendidly useful a reform."

First Principles for Young Mechanics.

By Coleman Sellers.

A well grounded knowledge of the great law or principle of conservation of energy should be taught with the multiplication table. It can be so taught if the teachers themselves are certain that there is in the universe only so much energy, and that we cannot make one particle more than already exists. With a clear understanding of this principle, no time will be wasted in search after perpetual motion machines, and fewer mistakes will be made by really earnest seekers after improved machines for use, or improved methods. When a young man brings to me some wonderful improvement over the ordinary crank motion, some device that is to supersede the crank of the steam engine, a feeling of utter helplessness comes over me; I know not where or how to begin; he has had no opportunity to learn the simple laws of mechanics, and to point out the fallacy of his argument means to teach him the laws of mechanics; so I can only say to him "Don't," and may advise him what books to read.

We hear or read almost daily of the wonders of science, and what is to be accomplished by electricity. "It is to be the great power of the future." Is it a power now? We may use it indirectly to drive machinery, we may make use of it to propel the cars on our street roads, but is it a power in the sense that steam is a power? Let us think of this a few moments. We call steam a power, and our factories are driven by steam power; or we call water, when falling, a power, and we drive the machinery in other factories by water wheels; or we pump water into the reservoirs at Fairmont by water power. Where we have no fall of water, and where fuel is scarce but wind plenty, we grind corn in a mill driven by wind, and the wind is our power; these and other sources of power may be called primary powers.

Secondary power is that which is transmitted from the prime motor to a machine. One machine may be driven by belt power, and another may be driven by gearing, &c. Electricity, as we now use it, as a power must be classed in its greatest economy with the secondary powers, with the belt or the gearing, not with the steam engine and the water wheel. We dig from the earth coal that contains the stored-up energy of the sun's heat expended on forests that existed long before man came to live on this planet. We burn that coal under our boilers, and the steam generated by this application of heat to water is used to drive the piston of the steam engine, and from thence is the power conveyed by belt or gearing by shafts, or even by electricity, to the machines to be operated. We can burn up zinc in costly acids, and generate electricity that can be used to drive an electric engine, and so in turn operate machines exactly as in the case of the steam engine. In this case electricity is a power exactly as steam is to be considered as a power; and what is more, the electric battery will give us more nearly the whole of the stored-up energy of the metal eaten up in the battery than the most improved steam engine can give us of the stored-up energy of the coal that is devoured in the furnaces under the boilers. With all this advantage, electric batteries are not used to drive machines with any hope of economical results.

Zinc has been gathered from the earth as an ore, it has been converted into a metal, or the metal has been gathered from the ore by means of coal and much labor; its market price is measured by the cost of its production. To burn up zinc at 5 cents a pound in acids costing but few cents per pound, with a certainty of getting from the metal 70 or 80 per cent. of its theoretical energy in motive force, yet makes the venture a more costly one than the burning of coal under a boiler with the knowledge that we are at the best getting but little more than 10 per cent. of the theoretical power that lies hidden in that coal. The electricity that is now lighting our streets, the electricity that is utilized in places to drive the street cars, has behind it the steam engine or the waterfall, the windmill, or some other motor.

By means of a steam engine we drive a dynamo electric machine, and the electricity thence proceeding lights our streets, or may be reconverted, with some loss, back into the power that created it; for one dynamo machine can be made thus to drive another, the electricity being carried from one to the other by proper conductors. What, then, is electricity as we now use it in the way of power, but as the belts and the gearing that carries our steam power to the machines? It is a belt with more or less slip. But this is not to remain so forever. The future of electricity as a power is full of promise. The coal we now squander, using but a small percentage of its theoretical dynamic force, is capable of yielding its energy either as heat or as electricity; and the time will come when we will not burn this coal to boil water, and in that boiling lose say 1,000 units of its heat at the moment of the conversion of water into steam—lose all this, never to be getting it back, but we will take from the coal its energy in the form of electricity, we hope in more near ratio to its true value, and then we can convert that energy into whatsoever other form of energy we may require. The best that science can do is to point out just what energy there is in this or that source of power. The most we can hope to utilize of this energy as power will never amount to 100 per cent. Nature gives us nothing without exacting something in payment.

A pound of water is the same as a pound of metal so far as its power from gravity is concerned. In falling through space it will exert just as much force as any other pound weight is capable of doing, and no more; it will do the work due to one pound falling at any given velocity, less the friction of the machine or of the moving parts. We turn water into steam with a certain knowledge of the power that can be gained by using the elastic vapor as a spring, or we may tear the gases, which combined form water, apart, and use these gases in re-combination to produce power, but less power than was taken to tear them apart, never more.

Science has made us so sure of these facts that we can base our faith on them, and with this knowledge we are willing that others than ourselves shall invest their money in machines which are claimed to be able to develop from five drops of pure water, inclosed in a ball, power enough to propel the largest steamship across the ocean. It is ignorance of the unalterable laws of physics that leads ignorant people into squandering money on so-called wonderful inventions that, out of nothing, are to give us great results. An ignorant man will spend his time pondering over perpetual motion machines, so will a man with his brain gone wrong; the first will quit his folly with more learning, the second finds his home in a madhouse. A third and worst class aim to deceive, and, for a time, many a one has done so. When shrewd ignorance resorts to dishonest methods, the confiding public is apt to suffer in pocket.

Electrical Progress in the United States from an English View.

Our contemporary, *Engineering*, says: "At the last meeting of the Society of Telegraph Engineers and Electricians in London, Mr. W. H. Preece, F.R.S., gave a most interesting discourse on the present condition and future prospects of electrical engineering in America. The author visited America in 1877, in order to inspect the telegraph system there, on behalf of the Postal Telegraph Department; and his second visit was paid during the meeting of the British Association at Montreal, and the holding of the Electrical Congress at the Philadelphia Exhibition.

"After reviewing the work done at both of these scientific gatherings, Mr. Preece went on to speak of the general progress of telegraphic industry in the United States, remarking that since 1877 we in England had advanced more rapidly than our cousins, a remark which is contrary to the received opinion. It is to be taken, however, in a scientific rather than a material sense, for as Mr. Preece states, the mileage of telegraph wire has increased from 200,000 in 1877, to 433,726 in 1884, while the number of messages per annum has increased from 28 millions, to 48 millions, in the same space of time. The number of offices has risen from 11,660 to 13,600, and the capital invested from 40 millions to 80 millions of dollars. One telegraph novelty had indeed appeared, namely, the Delany multiplex system. Mr. Preece speaks very favorably of this rapid telegraph, and hopes to try it on the Postal Telegraph lines. The apparatus itself will, we understand, be exhibited at the forthcoming International Inventions Exhibition in South Kensington.

"Passing from telegraphic to telephonic operations, Mr. Preece alluded to the recent attempt to upset the Bell patents on the ground of Drawbaugh's claim to priority of invention; an attempt which has failed. The decision will, if unreversed, give an impetus to telephony in America by preventing threatened litigation. From 150, the stock of the Bell Company has risen to 250 in less than six months, owing to the termination of the case in the Circuit Court.

"The telephone in America (to return to Mr. Preece's lecture) is used on a far more extensive scale than in this country, notwithstanding the fact that it is far more heavily taxed than here, one company being taxed as much as 75 per cent. of its receipts. The reason of this is that it is a vital necessity to business, partly owing to the excessive heat during summer. The charges for the use of the telephone are also much higher in America than here, the annual charge for the "law" exchange system employed by lawyers being 44*l.*, while the ordinary charge is 35*l.*, as against 20*l.* in London. In some American towns, however—for example, Philadelphia—the rate is 25*l.*, and in Buffalo the charge by results at a tariff of 6, 5, and 4 cents per call, according as the minimum number of calls is 500, 1,000, and over 1,000 per annum.

"The exchange system is very promptly worked in America, the maximum time of 'putting through' being four seconds on the Milwaukee lines. There are 10,600 subscribers to the exchanges of New York alone, whereas, in all England there are only 11,000. In the whole United States there are 97,400 circuits, comprising 90,000 miles of wire, and some 517,000 instruments have been manufactured.

"Turning to electric lighting, Mr. Preece remarked upon the extraordinary progress it has made in the United States as compared with Great Britain. There are some 90,000 arc lamps alight every night in the States, and in most of the large cities the streets and warehouses are brilliantly lighted by them. The contrast between New York and London in this respect was, as Mr. Preece stated in a recent lecture to the Society of Arts, most depressing. 'On the evening of October 21st,' he said, 'I drove from the Windsor

Hotel, New York, to the Cunard Wharf, a distance of about four miles, through streets entirely lighted by electricity. On October 30th I drove from Euston to Waterloo without seeng a single electric light.' One manufacturer told him that he was turning out 800,000 carbons for arc lamps per month, and another that his output was 50 arc lamps and 3 dynamos per diem. There are many central stations working regularly, both with arc and incandescent lamps, and more than one electric light company pays dividends; while the manufacturers seem to be full of work.

"The principal systems in use are, for arc, the Brush, Weston, and Thomson-Houston; but there are other systems not so well known on this side of the Atlantic, as the Van de Poele, the Western Electric, and the Remington. The chief incandescence lamps employed are the Edison, Weston, and Swan.

"In his lecture to the Society of Arts, Mr. Preece entered rather more fully into this part of the subject than at the Society of Telegraph Engineers, and we will therefore refer to some of his observations at the former place.

"The Weston system struck him as one of the best in the United States from a mechanical point of view. The great suspension bridge at Brooklyn is lighted by it, forming a very splendid spectacle on a fine night. New York harbor will also soon be lighted. The dynamo is remarkably free from sparking, the 'Foucault' currents are checked, the resistance of the armature (.0011 ohm) is so low as to be negligible, and the dynamo becomes practically self-regulating; while the electromotive force is a safe one, being only 70 volts when the machine is running at 1,000 revolutions per minute.

"We need not follow Mr. Preece in his accounts of the various systems above mentioned; but we may mention that it is at length decided to light the streets of Ottawa with the Thomson-Houston system by power derived from the celebrated Chaudiere Falls. The Thomson-Houston Co. have already a central station at Montreal, supplying 164 arc lamps to the streets of the town at the rate of 50 cents per lamp per night, the lamps being lighted from dark till midnight. Here, as in the case of the Brush central stations, the current is carried by overhead wires erected on posts, the wires being of copper (No. 6 gauge) covered with asbetos, and cotton. In Philadelphia Mr. Preece inspected a Brush central station supplying nearly 1,000 lamps and utilising 1,200 horse-power. There were 25 circuits, some four miles long, of overhead wires. The charge for each lamp is 25 dols. per month, which is equivalent to 70*l.* per lamp per annum.

For street lighting the lamps are suspended from tall posts running in a zig zag line and about 50 yards apart. An experiment in general illumination by eight Brush lamps on four iron masts 250 ft. high, which Mr. Preece saw at Cleveland, did not recommend itself to him, the streets below being lit by what seemed a very pale moonlight. We may add that the price paid in New York is 70 cents per night, or 50*l.* per annum for each arc lamp; but a fine of 1 dol. 40 cents is imposed on the lighting company every time a lamp is reported to have been out.

"Aerial wires are in general use in the States, except in connection with the Edison system. They are in general of copper covered with hemp or cotton, and supported on poles erected along the kerbstones. High tension currents are also in frequent use, and the immunity from accident is therefore surprising. Fires are, however, not so rare, and the currents often leak into the telephone wires. In fact it is becoming the practice to put safety cut-outs in the latter to protect the instruments from leakage currents. Secondary batteries have not received so much attention in America as in England; but the Plante and Brush cells are both in use to a limited extent.

"Ship-lighting is becoming very common in America, many of the Hudson River and Lake Superior steamers being lighted by electricity. So also are the ferry-boats of the Pennsylvania Railway. In short, Mr. Preece considers that electric lighting as a practical problem has been thoroughly solved in the United States; and that both here and there it will gradually become cheaper. Its peculiar advantantages will lead to its general introduction; and one of these, which has been observed in America, is the prevention of crime. The chief of the New York police has even said 'every electric light erected means a policeman removed.'"

Electrically Propelled Tramcars.

In the *Electrical Review*, as in other technical journals, much has been said with regard to the substitution of electrical energy for horse-flesh for propelling tramcars.

There is at the present moment an interesting discussion going on between the members of the Institution of Civil Engineers on the subject of steam-tramways, and this is, therefore, not an inopportune time to make it known that during the last few months a series of important experiments has been carried out in a quiet and systematic way with a view of determining the value of secondary batteries, in conjunction with electromotors, for the propulsion of tramcars in crowded cities.

The gentleman with whose name these valuable tests are associated has already done much serviceable work in this direction, and we may now positively state that Mr. A. Reckenzaun, C. E., has designed, and the Electrical Power Storage Company conducted, a really efficient apparatus which promises to give the handiest means of locomotion that has ever been placed upon street rails.

For more than two months past a car has been travelling on a line laid down for experimental purposes by the before-mentioned company in its extensive premises at Millwall. The tramway (4 ft. 8½ in. gauge) is 400 ft. in length, and, from the nature of the ground-space at the company's disposal, forms approximately a right angle of nearly equal sides, the apex of the angle making a curve of only 35 ft. radius.

From one end as far as the commencement of the curve, the road is tolerably level, but with this curve commences an incline of 1 in 40, gradually rising until it reaches a maximum of 1 in 17 near the end of the up-journey.

It is, therefore, a matter of impossibility to make a rush for the hill on account of the sharp curve intervening, and the experiments made on such a difficult line are consequently of more than ordinary value.

The car itself is an old one procured from one of the metropolitan tramways, and it has done many years' service whilst drawn by horses on the Greenwich-Westminister line. The body of this vehicle weighs 2¼ tons, and it accommodates 46 passengers.

Tramcars propelled by secondary batteries have been made and experimentally run in London, Paris, and Brussels, but, hitherto, little or no success has attended the efforts of the promoters of the systems involved in these trials. Many electricians and scientists have emphatically pronounced the accumulator method of obtaining motive power for such purposes as impracticable, the main reason for this denunciation resting on the fact that the batteries were much too heavy, and that the bulk of their stored energy was wasted in propelling their own weight. The Electrical Power Storage Company has, however, found good reasons for believing that the contrary can be proved, and that in the future the motive power appliances will form but a minor portion of the total weight of car and passengers. The secondary cells furnishing the electrical energy for the car under notice are of a special type manufactured by, and under the patents of, the Storage Company, to the designs of Mr. Reckenzaun. Placed under the seats of the car in long trays, which run on rollers for their speedy removal, they are out of sight, and the whole car internally and externally has nothing whatever strange in its appearance; it looks indeed similar to an ordinary tramcar propelled without horses or other visible motive power. The electromotor and gearing (made under Reckenzaun's patents) are placed beneath the car and occupy so little space that, to a casual observer, they are unperceived. The absence of noise, vibration, or any disagreeable feature, makes a journey in this car most enjoyable. The speed may be varied from 3 to 10 miles an hour by a most simple contrivance, and any person quite unacquainted with technical details can drive with perfect confidence. Returning again to the secondary batteries, these have been of late so much improved that great power may now be drawn from a small weight of material without sacrificing either efficiency or durability. The weight of the cells employed in propelling the car is about 1¼ tons, the motor, gearing, and accessories bringing up the total weight for motive power to 1¾ tons; and this for a car which, with its full complement of passengers, weighs in itself 5½ tons. The electrical arrangements are such that if at any moment it should become necessary a power equal to that of 16 horses can be furnished.

Comparing the above weight, says Mr. Reckenzaun, with that of a steam or compressed air tramway locomotive, either of which will weigh some eight or ten tons to do the same amount of useful work, it must be admitted that stored electrical energy has the advantage in proportion of about 5 to 1 so long as the propelling force is directly proportional to the weight moved. Much has been written concerning the waste of power which occurs when secondary cells are used for the purposes of locomotion. The conversion of energy has to pass through various stages, which we need not particularize; but we are assured that it can be shown, from prolonged experiments and practice, that the total loss of energy, with all its transformations, is only 66 per cent. between the steam engine used for driving the charging dynamo and the tram rails. It is known that tramway steam locomotives consume from three to four times as much fuel per horse-power as large stationary engines such as would be employed for actuating dynamo-electric machines, and bearing this in mind, an efficieney in the electrical tramcar far below that quoted would still be considered economical. The prime cost of electrically propelled cars with the charging stations would be less than that for steam cars, and the depreciation, repairs to machinery, etc, must also be less on account of the few wearing parts, and the complete protection from dirt. As far as the accumulators are concerned, their depreciation is low, as lead is cheap and the renewal of positive plates easy, involving but little skilled labor.

The running cost, including 15 per cent. depreciation on machinery and 50 per cent. on accumulators, comes to 3¼d. per car mile, which is about one-half the expense attached to "horsing" on tram lines.

The car on the line at Millwall runs for two hours with one charge, starting, stopping, and reversing every minute, and the discharged batteries can be replaced almost as quickly as is the case when changing horses. This is accomplished by means of a trolly, which brings up and removes the trays of cells, the trays, as already stated, running on rollers.

The whole of the arrangements, both electrical and mechanical, have been well and carefully worked out in every detail. The entire weight of the car is properly distributed over the small "bogie" frames, so that no objection can be raised on the part of tramway companies using light rails laid for horse car traffic. Old rolling stock can be readily utilized by merely placing the "bogies" which carry the motor under the car, and fitting the space under the seats for the reception of accumulators. The car is brilliantly illuminated at night by four 20-candle power Swan lamps, and bell pushes inside the vehicle enable the passengers to signal to driver and conductor at the same time, by the ringing of electric bells.

We were considerably impressed, on the occasion of a recent inspection, with the admirable and really practical results obtained; and we have no hesitation in saying that electric locomotion should make a decided advance through the medium of Mr. Reckenzaun's persistent endeavors. We shall hope ere long to be able to chronicle the complete success of this car in practical working in competition with horses, the intention being to run it publicly in a few days.—*London Electrical Review.*

Protection from Lightning.

Considering the length of time that has elapsed since Franklin's experiments with a kite, and the enormous advances since achieved in general electrical science, there has not been, we fancy, commensurate progress made in lightning conductors or protectors, and this important field for invention has been, comparatively speaking, but little worked.

There are various systems of lightning conductors in use, and yet experts will confess that in many cases it is doubtful if they really protect the buildings to which they are attached, and it appears to be pretty clear that in some cases, at least, so far from being a source of safety, the lightning rod has been actually a source of very considerable danger.

It has been well said that the annual damage through thunderstorms is considerable, especially if loss of life and destruction of property be considered. Some idea of the loss sustained from the effects of lightning may be inferred from the list of casualties published in the *Meteorological Magazine*, whence it appears that during the last quarter no fewer than 35 persons were killed by lightning, and 91 were more or less injured. "As regards the other items," says the magazine, "we have tried to form an approximate estimate—a very wide one, we admit, but one in which we have tried to keep the amounts low, and in which probably errors will neutralize other. Leaving the people out of the calculation entirely, the damage recorded comes to nearly £10,000; and, had all damages been reported and proper records kept of the values, we have no doubt that it would be nearer £30,000 than £10,000." In the three months evidence has been received that no fewer than 20 churches have been struck in different parts of the country. There have also been more or less severely smitten 112 houses, 10 cottages, 21 barns and sheds, 11 factories, 42 chimney stacks, and 32 ricks of one kind or another, 14 of them being destroyed. So far as we are aware, there has been no systematic observation of thunderstorms in Great Britain, nor are scientific men agreed upon any method of protection. The value of lightning rods in the protection of buildings is acknowledged, and that is about all. No one, for example, has yet endeavored to promote a bill in Parliament obliging landlords to protect houses against lightning, although, were our boasted civilization but a little more "evolved," that is a consummation to which we should surely come. If we mistake not, Prof. Tait, in the last edition of the "Encyclopedia Britannica," says three things are necessary effectually to protect buildings from lightning—(1). The points should so project from the building or ship to be protected as to prevent any great development of electrical density elsewhere than on themselves: (2). they should be effectually connected with the earth; and (3), the connecting rod ought to be so good a conductor as not to be injured even by a powerful electric discharge.

This is all very well so far as it goes. Unfortunately, it has not yet gone to any really practical length; and, not only are most houses and buildings left entirely unprotected, so far as lightning is concerned, but, unfortunately, science and invention have not as yet succeeded in giving us a perfect lightning conductor competent for all exigencies, and one on which absolute reliance can be placed.

Prof. Tait has lately formularized some highly-instructive observations on lightning, but it is quite certain that this important subject, as yet, has not received proper attention, either from inventors or those who have professed to equip buildings, so as to render them absolutely safe against any kind of electrical storm. We are, for our part, convinced that before long it will be universally understood that all buildings of any value, and most certainly all dwelling-houses, will have to be properly protected against lightning; and thus there opens out, in a comparatively new field, practically unlimited opportunities for invention—opportunities of which inventors, we fancy, will not be slow to avail themselves.—*Invention.*

Electrical Review.

Published Weekly at 23 Park Row.

P. O. BOX 3329.

GEO. WORTHINGTON, } - - - Editors.
WM. A. HOVEY, }

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance.

Great Britain and other foreign countries, $4.00, in advance. Postage free.

ADVERTISING.

$75.00 per inch per annum.
Transient, 25 cents per line, nonpareil.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of ELECTRICAL REVIEW P. O. Box 3329, New York.

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

Mr. J. Viennot, 150 South Fourth Street, Philadelphia, is our accredited representative for Pennsylvania.

Messrs. Wm. Dawson & Sons, 121 Cannon Street, London, England, are our representatives for Great Britain.

NEW YORK, JANUARY 17, 1885.

CONTENTS.

	PAGE
The Electric Light in the Publishing House of Messrs Hachette, Paris	1
Lessons taught by the Philadelphia Electric Exhibition	1
The Metric System	2
First Principles for Young Mechanics	2
Electrical Progress in the United States from an English View	2
Electrically Propelled Tram Cars	3
Protection from Lightning	3
Editorial Notes	4
The Electric Light Convention	4
Editorial Notes from New England	4, 5
Telephonic News	6
Maiche Electrophone	6
Telephone Lines	6
Tubes Instead of Wires	7
Telegraphic News	7
An Absolute Standard of Light	8
Electric Light News	9
Electrical Patents	10

The Rhode Island Telephone and Electric Company, of Providence, who are licensees of the Time Telegraph Company, of New York, have one company organized and doing well in the City of Boston, another for the State of Massachusetts outside of Boston, and one for the State of Rhode Island. The States of Maine and Connecticut will soon have similar companies within their limits.

The Central Union Telephone Company, of Chicago, presents its stockholders with a New Year's gift in the shape of a quarterly dividend of 1½ per cent., and a number of other companies which have not done anything in this line for some time are in a fair way to follow suit at an early day. The fact is that the "stress" is about over, and that there are very much brighter times ahead for all the companies operating under licenses from the American Bell Company. The waiting has been long, and to many stockholders not a little tiresome; but it is safe to say that it is about over, and that the outlook is far brighter than for many months.

The Tropical American Telephone Company is getting into good shape, and its business is upon a substantial paying basis. It has declared one dividend, and has a surplus laid aside from earnings which warrants three more of equal amount. Comparatively, considering its territory and its sources of income, its capital is small. Its revenue comes from the sale of apparatus to its various sub-companies, all of which will be found enumerated in another column. It has a stock interest, usually 20 per cent, in each of these, and from this source it is hoped and believed a very considerable revenue will will eventually be derived. It has from the Bell Company the sole right to sell its apparatus for use in its territory, and succeeds to whatever patent rights or concessions belonged to the Bell Company in those countries. The telephone business is rapidly extending in South America and the West Indies, the demand for instruments is large, and there would seem to be no good reason why the company should not long continue in the path of prosperity upon which it has entered.

THE ELECTRIC LIGHT CONVENTION.

We are requested by the representatives of a large number of electric lighting companies to print the following announcement:

A convention of delegates, representing companies doing an electric lighting business in the United States and Canada, will be held at the Grand Pacific Hotel, Chicago, on Wednesday, February 25, 1885. Every electric lighting company in the United states and Canada is invited to send delegates properly accredited. Delegates will find headquarters established at the Grand Pacific on their arrival.

In the suit of the American Bell Telephone Company against the Overland Telephone Company of Pennsylvania, Delaware and New Jersey, brought for the purpose of restraining the latter from using a transmitter and receiver alleged to be infringements on patents owned by the plaintiff, arguments were begun in the United States Circuit Courts, in Philadelphia, before Judges Butler and Nixon, on the 7th inst., upon the long-pending motion for a preliminary injunction. It will be remembered that when the case was up before, the Judge declined to grant a decree, on the ground that much of the evidence before him was also before the Circuit Court in New York, and that it would be an act of discourtesy on his part to pronounce upon evidence which was imported into the case from one pending before another court. Since that time the other suit has been brought to an end by the decision of Judge Wallace, making permanent the injunction against the Drawbaugh people, and now the case comes up for decision. Mr. Chauncy Smith opened for the plaintiff, Messrs. A. I Keasby and Wheeler H. Peckham replied for the defendants, and Mr. E. N. Dickerson closed for the Bell Company. The Court took the papers and reserved its decision. Of course, it is fruitless to guess what this will be, but so far as it depends upon the evidence in the Drawbaugh case, which was, by agreement, put in *en bloc*, it is safe to assume that the very full and careful opinion of Judge Wallace will have great weight. The drop in telephone stock made it look as though some of the weak-kneed brethren were a trifle scared, but it re-acted promptly, as usual. Those who heard the arguments and are familiar with the evidence, say they see no reason to expect a decision unfavorable to the Bell Company.

Later. The decision is in accordance with the above prediction, and the Overland Company, by a decision rendered on Tuesday, is under temporary injunction. Next!

EDITORIAL NOTES FROM NEW ENGLAND.

My first call in Providence was on Mr. Duxbury, of the Rhode Island Telephone Company. I found him full of work, full of news, and full of plans, as usual. His latest move has been the organization of the Providence Time and Messenger Company—a corporation which takes the license for the Time Telegraph for Providence, and also undertakes the messenger business, "thusly:" Across the street from the Butler Exchange, in which the Telephone Company is located, an office has been opened by the new company. In its time department it has over five hundred clocks running. It is connected by wire with each board in the telephone exchange. If a telephone subscriber wants a messenger, he rings up and says so. The operator at once connects him with the wire running to the office across the street, and rings it up. The party in the office talks with the subscriber, ascertains his wants, and sends a messenger accordingly. Thus a good and prompt messenger service is supplied without call-boxes or additional wire; the telephone becomes additionally valuable to every subscriber; those who do not have it see a new reason for taking it, and a very good business is established for the new company without the investment of much capital. Do you ask how the Telephone Company is compensated for the service rendered? Don't worry about that. Providence people and companies are not given to rendering services in a business way without keeping an eye to the returns, and there is no exception in this case. The office of the new company is a public telephone station, for which the Telephone Company pays no rent. Moreover, the Time and Messenger Company, through its boys, does a great deal of outlying collecting for the Telephone Company, and, in one way and another, gives quite as much in the way of service as it receives.

In Mr. Duxbury's office I met Mr. Lytle, who was down from Boston on business. He tells me that work on the new insulators at Haverhill is progressing favorably; that the tools for making the new English (Lewis "screw top" insulators are about ready, and that they expect to turn out a big lot soon. By the way, a funny thing. Insulators in England are made of earthenware, glazed. They "come high" over there—not far from sixteen cents each. They are made in a lathe, fired, then glazed, then fired again, and are such handsome pieces of pottery that one wonders they are not put up in velvet-lined cases like Sevres cups. Why are they made of earthenware? Because in England, you know, we always use iron pins—not the wooden things you stick up in this country, don't you see? Now, if we put on glass, the sun shines through it and don't heat it, but it *does* heat the iron, you know, expands it, and cracks the glass. But if we use earthenware, don't you see, the sun can't do it, you know. Poor things, it never occurred to them to use *opaque* glass, simply because they never *had* used opaque glass; but I am of the opinion that when Mr. Lytle gets over there with a few thousand screw-top insulators, made in one motion with a perfect inside thread, and of a beautiful white glass that the sun can't shine through, any more than it can through a piece of iron, and offers them at less than one-half what it costs the manufacturers over there to turn out their hand-made Keramic specimens, the folks will wake up to the idea that "those blasted Yankees" still have an idea or two that they have not as yet had any conception of. By the way, Mr Duxbury tells me that he has tried some of the new insulators of the "pony" size, and likes them very much indeed.

I need not say that the Telephone Company in Providence is doing excellently well. That seems to be its chronic condition, and its subscribers continue to increase and multiply. There is an air of prosperity about the place that is gratifying, and an eagerness to know about all new things—and to invest in them if they promise well—which show that there is something more than an *air* of prosperity.

Providence is one of the stations of the new copper circuit, which is working very well most of the time now. I do not understand that there is as yet a very great deal of through business between Boston and New York, but I do understand that what may be called "way" business is very good and constantly increasing. There are a number of firms having factories out in Connecticut and offices in New York who are "looped in" to the copper circuit by double loops, and use the line very freely and satisfactorily, to their very great business advantage.

Of course I went to see Mr. Eugene Phillips at his factory, and received, as does every one who has the good fortune to meet him, a cordial reception. He is hard at work, as is everybody about the place, although, owing to the general depression, hours have been shortened somewhat in some departments. It would take more space and time than I have to spare to tell of all the things made here, and besides, everybody has a general idea of their nature. Mr. Phillips was good enough to let me see through a number of the rooms, although there are some that he very wisely and prudently keeps under lock and key. I have sometimes heard people complain about the high price of insulated wire of various kinds, but I am satisfied that if they could see the many processes through which it must pass, the amount of machinery required, and the great care devoted to securing perfect insulation, their complaints would cease. Again I was surpised at the great variety of product, suited to many varied uses. One of the latest things is an insulated double conductor, to be used in running loops from the copper circuit. The centre is a copper wire Then comes rubber insulation with, I think, cotton braided around it. Next comes a wrapping of fine iron wires, forming the second conductor, and outside of this again more insulation, double, if my memory serves me. The whole is nicely finished on the outside, paraffined, and looks like a handsome cord. I saw some novelties, too, in the way of telephone cords, with special provision for taking up the strain in case of the instrument being allowed to fall from the hand.

One of the specialties of this establishment is the making of very fine wire for magnets, resistance coils, and delicate instruments. It is no joke to make a wire which shall be perfectly true, of uniform weight and resistance per foot, and measure *exactly* $\frac{1}{100}$ of an inch in diameter, especially when the requirement is added that it shall be in very long lengths. How is it done, did you ask? Well, it is drawn through holes in precious stones. How are the holes made? That is the question which I did not deem it courteous to ask, and which probably would not have been answered if I had. Of course they are drilled, and the drill is charged with diamond dust, but how they get a drill which is only $\frac{1}{100}$ of an inch in diameter rigid enough to stand up and do its work under the pressure necessary to drill through a gem almost as hard as a diamond is more than I know. But the interesting fact remains that they do it, and out of this grows the further fact that they make a great deal of very fine wire of a very superior quality, and that it is in great demand among those who have occasion to use such wire, whether naked or wound, in making coils to be used in electric lamps, telephones, galvanometers, etc. It saves a deal of labor and time to have a wire whose exact resistance can be determined by its length without testing, and hence the popularity of the wire from this establishment.

Of course I went into the cable room. The conductors are first insulated separately with rubber. Then one in every group of nine is enveloped in tin foil, to take off the induced currents and carry them to ground, and then the insulated conductors are "bunched" in a long spiral. This is wrap-

ped with tape, a covering of material similar to the tape is then put on and cemented, making it water-tight, a wrapping of tape in a close spiral goes over this, and then the whole goes through a most ingenious loom which weaves a solid covering over it. This is painted, and then the cable is done. It has given excellent satisfaction, and people who have had it in use for three years and over tell me that it shows no deterioration whatever.

I was glad to find that the Narragansett Electric Light Company is doing so well. It is one of the offspring of the American Electricing and Illuminating Company, and its advent into this world was full of pain and peril. It was fought at every point by the local Weston Company, and called by every conceivable name except that which rightfully belonged to it. It was a puny and unpromising infant for quite a time, but, despite the way it was sat upon and even stamped upon, it comes up smiling, and is a good deal more prosperous to-day than the rival that tried so hard to strangle it at its birth. It is earning at the rate of fully ten per cent. per annum on its capital, has one of the very best equipped stations in New England, and, "taking one consideration with another," is a child of which its parent may well be proud. Its lights fairly drove those of its competitor off the streets, and they are so much in favor with the people that I doubt if any contingency can arise which can secure their removal. At all events the company is in the hands of Providence men now, and, in case of another tussle, the Weston folks cannot raise the Chinese cry of "foreign devils" as they did before. To a Rhode Islander, everybody who lives beyond the confines of the plucky little state is a "foreigner."

Quite as much as a matter of pleasure as of business I called at the office of the Armington & Sims Engine Company. Mr. Sims is away—down South somewhere—and I missed him sadly, but I had a very pleasant call on Mr. Armington, whom I found enjoying himself in an easy chair in front of a bright wood fire, chatting with a friend. His talk was of engines generally, and of "valves," "cut-offs," and "indicator cards" in particular. Near him was his drawing board, at which he has been at work without intermission since his return from Europe three or four months since. He has recovered his health, and is entirely himself again. His idea is that nothing is so good that it cannot be improved, and unless I am greatly mistaken this idea will take practical shape in the form of a much modified and greatly improved Armington & Sims high speed engine before the leaves come in Spring. It is an eye-opener to look over such a set of drawings as be showed me and see the amount of careful, painstaking, detailed work required in order to get everything just right. We adjourned to Mr. Armington's house for lunch, and had a delightful hour at his hospitable table, forgetting all about business in our talk of things in the old world. It is a pleasant thing to take an hour's trip to Europe in that way, summon up the old, interesting scenes, tell the old stories and old experiences once more, and then come back to business, none the worse, but a good deal better "braced" for it than if one had stuck to it all through. Mr. Armington, like a sensible man, put in a great deal of his time in England, and what he saw he saw thoroughly. Being a man of taste, he fell in love with the Isle of Wight, and made it his home last winter. Happy man!

I am proud to say that, before leaving Providence, I thoroughly poisoned one man's mind on the subject of an electrical launch. It is little short of a scandal that in this broad land there has not yet come to the front one single man who had the means, the interest in the practical development of electricity, and the "gall" to build and own an electrical launch. I rejoice to say that Mr. Duxbury is thoroughly committed to it, and I desire to place the fact on record right here. His promise is that "when the spring-time comes" he will have an electrical launch afloat on Providence river, fully equipped, and in commission. I wanted him to promise to call her the Volta, but he didn't tackle kindly to the idea, probably because he has some other name in mind, some name that does not recall a person quite so ancient, therefore I didn't insist. But it was distinctly promised on his part that the boat is to be ready, and on mine that I am to sit in the place of honor in the stern sheets on the trial trip, whose objective point is to be one of those harbors of delight down the river where clams give up the ghost under a covering of steaming seaweed. More than this, I am to give a description of the launch to the readers of the REVIEW, with plans, specifications and dimensions, and so much of an account of the trip as seems right, proper, and discreet. Mr. Phillips will probably be invited to join the party. This is under advisement.

It may be that there are slower trains than those of the "accommodation" persuasion which ply between Providence and Worcester. But let us hope not. Doubtless they afford "accommodation" to those who travel that way in the shape of shelter and repose, but, were time an object, it seems almost as though walking would be more satisfastory. However, we did reach Worcester in time.

I had a pleasant call at the telephone office, and an interesting chat with the Manager, Mr. Smith, who has been there ever since the telephone made its advent in the "Heart of the Commonwealth." He is using the Providence board, but tells me that he is intending to make some changes in it which experience has suggested to him. The exchange is in first rate working order, and is giving good satisfaction in the city. Curiously enough, they are still using some six or seven hundred of the old tap bells, run by a battery. Subscribers seem to like them, and, as the cost of substituting magnetos would be large, they feel justified in continuing them, for the present at least. Of course the expense of running the batteries is constant, and in time will equal what would have to be put out for magneto bells, but it doesn't go out in a lump, and is not seriously felt.

There has been a good deal of growling, first and last, about the talking between Boston and Worcester, so I tried it. I got Mr. Smith to call up a friend for me down there, and had a pleasant five minutes chat, during which I obtained the important information that there was no news, that everybody was well, and that everybody hoped I was. Funny that people should always say there is no news. There was news, and the man I was talking with at that very moment knew things that I didn't know, and he knew that I wanted to know. But it never occurred to him to tell me. Perhaps it is because he is unused to the telephone, and the use of it drives all ideas out of his head. He is always newsy enough when I meet him face to face. He is a Lowell man, and his name is William A. Ingham.

The Electric Light Company in Worcester, another child of the American Electric and Illuminating Company, is doing first rate, and is running up to its full capacity of two hundred lights. More are called for, and the Mayor, in his inaugural the other day, not only said that the city needed twenty-five more, but indicated the places where they ought to be put. By this time next year the company, which is doing first rate financially, and earning liberally right along, will certainly have three hundred lights, if not more. It is a snug little company, with first class construction and excellent business management, and is bound to prosper.

The Time Company's business is not receiving proper attention, and is suffering in consequence. A *stopped* electric clock in a public place like a broker's office where business men congregate to discuss stocks and watch the market—no, it is not a "bucket shop"—is by no means a good advertisement. I trust it will be speedily corrected.

Naturally I went to see Mr. Theodore C. Bates, first because it is a pleasure to call on a man so full of good nature, and second because he is always "in" and a part of every new thing that is going. He confirmed what I had heard about the Electric Light Company and then we had some talk about the proposed Edison plant for Worcester. The money, $100,000, was all subscribed and ready, but it got to be late in the season, too late to have the plant in operation for this winter, and it was probable that the frost would interfere with putting in the underground conductors. So things are at stand still, and the project sleeps for the present. Mr. Bates has an isolated Edison plant in his factory, which gives excellent satisfaction. He is a thorough believer in the electric light, is convinced that it has come to stay and has a big future before it, and he has a convincing way of backing his belief with his money.

I journeyed from Worcester to Springfield in the "limited," a very comfortable train, with dinning car accompaniment. It belongs to the Boston and Albany, but is run by the Mann Boudoir Car Company, and everything is very elegant, with no end of tone. In fact there's more tone than food. In the "vulgar West" you get, on any one of a dozen first-class roads that I could name, a tip-top meal for seventy-five cents. To be sure the water is not served in cut glass decanters, nor do the waiters wear clawhammer coats and white cravats, but you are well served, and have an abundance of well cooked food at a fair price. The Mann Company charges you a dollar for a meal which, on the day I partook, was neither well cooked nor sufficient in quantity. The salt was excellent, and the napkins were of handsome damask, monogramed. The silver was similarly adorned. I am willing to pay for food, but I don't care to "blow in" good money for monograms. They are not filling. All of which is respectfully referred to Col. Mann.

At Springfield I called at the telephone office and had a pleasant reception from Mr. Guy Carleton, the Manager. Mr. Daybold, whom I met at the Convention and Exhibition in Philadelphia last Summer was away. The exchange is in a very pleasant corner room, well lighted, and is as neat as wax. There was no loud talking, and everything went on quietly and systematically. Cables are used to a very considerable extent in the city, and give excellent satisfaction.

Electric lighting in Springfield is done by a local company, using the Weston machines. I understand that, as the result of recent negotiations with the American Electric and Illuminating Company, they are to make a considerable addition to their plant, to consist of Thomson-Houston dynamos and lamps. It will afford a good opportunity to compare the two systems side by side.

My stay in Springfield was brief. I journeyed on to Hartford, reaching it late in the evening, but not too late to call round and see the electric light station in operation. It is a Thomson-Houston plant, put in by the American Electric and Illuminating Company. It is in a building which adjoins that of the Hartford Steam Company, from which it formerly hired steam. Now it hires three boilers outright, makes its own steam, and finds it to its advantage to do so. The company is doing well, earning money right along, and finds a constantly increasing demand for its lights, of which it is now running very hard on to two hundred. It had a hard fight at first with the gas company, but it came out ahead, and now furnishes the city with a large number of lights for the streets. The streets in which it is used are better lighted than ever before, and the cost to the city is actually less than when gas was used.

This company had an experience recently, from which all other companies doing electric lighting may learn a lesson. Somebody went into the engine room and, without being seen, unscrewed one of the oil cups and filled it half full of fine emery. It is needless to say that there was very serious trouble very soon after the engine started, and that it had to be shut down, taken to pieces, and cleaned. Fortunately, the trouble was detected before any very serious damage was done. The lesson to be learned from this is that the engine room should in all cases be kept locked through the day, and that at all times unknown persons should be rigorously excluded. Engines and dynamos are delicate pieces of machinery, and the more careful a company is to keep them secluded from anybody's touch, the better it will be.

For some little time the Hartford Electric Lighting Company ran a number of incandescent lights in the *Courant* office, I believe, by way of experiment. The current was the ordinary Thomson-Houston, and the lamps were of the Woodhouse and Rawson make. They gave excellent satisfaction. This company is running at the present time a number of the Thomson-Houston half-arcs, which are much liked, especially for interior illumination. They give ample light for a store of moderate size, and enough light is better than too much. The lines of this company extend over a very wide area. This has made the plant costly, but there is a certain ultimate advantage. When it comes to filling in—and it is surely coming—the number of additional lights required is going to be very large, and the business of the company is going to increase proportionally. The management of the company is in the hands of some of Hartford's best known and most substantial citizens, and its future as a substantial business enterprise is assured.

I chanced to be in Hartford on Inauguration Day. The weather was fine, and the citizen soldiery was out in full feather. Talk about the pomp and circumstance of *war!* I've seen war. There's precious little pomp about it. It's too serious. *Peace* is what brings pomp and flummery, fuss and feathers. I never see a company of militia in gaudy uniforms and gold lace without thinking of what Hosea Bigelow said: "Ef there *is* ennything foolisher than military glory, it's milisha glory." But this is digression.

Of course, I dropped into the telephone office, this being in the territory of the Southern New England. Saw Mr. Smith, who has charge of the operating room, and had a pleasant talk with him. He knows the business of his office from A to Z, and has given a great deal of attention to the details of his work. He has so doctored his spring-jacks that it is out of the question for a subscriber to be left cut off from the exchange, a difficulty which occurs far too often through failure to "clear out," and is always provocative of profane swearing. This is never justifiable, of course, but when a subscriber stands up to his instrument, presses the button and turns the handle, yet fails to make his bell ring, a sure sign that he has also failed to attract the attention of "Central" by making his drop fall, he feels weary and lonesome, and is not to be judged too harshly if he speaks some bad French. I noticed that Mr. Smith puts the cell of battery for each operator's transmitter directly behind the board at which she sits. Each is in a box by itself, covered and protected. He tells me that he thinks this is an advantage, and that the shortness of the circuit is favorable to good results. In most cases, I think, I have seen the transmitter batteries in closets at some distance from the boards.

The Schuyler Electric Light Company has its office and factory in Hartford. Its apparatus, like the company itself, has had a good deal of overhauling, and is now in very promising shape. It had the good fortune, about six months ago, to secure the services of Mr. Gustav Pfannkuche (pronounce it "fan-cookie") as its electrician, and since his advent very remarkable progress has been made. He is an Austrian, thoroughly educated in the first place as a civil engineer, and during the last four or five years has

(Continued on eighth page).

Telephonic News

*** General Manager Vail, of the American Bell Telephone Company, Boston, returned from his European trip last week in the best of health.

*** If machinery in New Orleans can be started by a man in Washington by electricity, "Why," asks a Norristown man, "can't an electrical contrivance be introduced that will enable a man to start the fire in the morning and cook the breakfast without compelling him to get out of bed?"

*** The National Telephone Company has decided to open public telephone offices in Aberdeen. Anyone may converse with a subscriber for three minutes for 6 cents, within a radius of 6 miles. Each additional minute will be charged for at the rate of 2 cents. Three telephone central offices have also been opened in Edinburgh.

*** Col. C. Jay French, for several years superintendent of the Railway Mail Service, recently resigned to accept a position with the American Bell Telephone Company at Boston. In severing his connection with his employes in Cincinnati they presented him with an elegant gold watch and chain and silver water service.

*** Mr. Preston C. Nason, general manager of the telephone company operating exchanges in San Domingo, has been in and about New York, arranging for material for new construction. Copper alone is to be used, and this week he shipped fifty miles of the Palmer Wire Company's hard-drawn wire, which will be put up at once.

*** With the view of ascertaining the difference of magnetic moment in a solid cylinder and a bundle of wires, P. Bakmetieff filled a hollow cylinder, 148mm. long and 32mm. inside diameter, with iron wires of 1, 2 and 5mm. diameter, and magnetized them by more or less intense currents. The magnetic moment of the finest wires, as well as its specific magnetism, considerably exceeded those of the two others, especially in the case of intense magnetizing currents. But when, instead of filling all the free space of the cylinders, he only inserted an annular layer of iron wires, the specific magnetism of the fine wires became, from the same current, many times greater than that of the thicker wires.

*** In a note published recently, there was a reference to the attacks made upon the Société Générale des Telephones, by the Municipal Council of Paris. Not having any personal interest in the question, the writer cannot be accused of partiality in saying that in the debate which recently took place on the subject, sufficient consideration was not paid to the delicate situation in which the company is placed as regards the charges imposed by the State and the Ville de Paris. A few days since a French journal referred to the exaggerated amount of the annual subscription which is no less than 600 francs, and which is twice as much as it should be. In the notice referred to, the charges made by telephone companies in different countries are given as follows:

	francs.
London	500
Austria	from 225 to 375
Germany	250
Italy	from 115 to 175
Norway	" 100 to 200
Holland	250
Portugal	375
Sweden	from 160 to 270
Switzerland	" 100 to 250

It would appear unwise to hurriedly deduce from this superficial comparison a condemnation of the manner in which the French company conducts its business. As M. Marius Martin, member of the Paris Municipal Council, remarked, the taxes that have to be paid to the Government and the city of Paris, have to be added to the subscriptions. It remains to be ascertained how much the reduction or suppression of these taxes would assist in diminishing the price paid by the public. The result of such a modification would be of much interest.—*La Lumiere Amerique.*

*** The Tropical American Telephone Company announces a dividend of 10 cents per share, its first dividend, and the first of any American telephone company operating in foreign territory. The issued share capital is $361,180 (36,118 shares, par $10), 3,882 shares remaining in the treasury. As the stock has never, it is believed, sold above $2.50 per share, and most of it cost the holders less than $2, this dividend is at the rate of 8@10 per cent. on the investment.

Maiche's Electrophone.

In this instrument the transmitter and receiver are now combined. The transmitter originally consisted of two distinct portions—a vibrating plate receiving the sound waves, and an organ transferring them into electric waves. The invention consists in the arrangement, on two parallel lines, of any number of carbons, separated by a certain space and breaking joint, so that the spaces between two consecutive carbons of the same line are opposite the carbons of the second row. These carbons carry others laid at right angles to the preceding, so that their ends rest on two of the carbons in the first row. The vibrating portion consists of a glass bell on which are placed the carbon contacts, as near the edge as possible. A battery current traverses all the carbons, which vibrate with the bell on speaking into its mouth. These vibrations cause differences of pressure between the carbons, and consequently induce currents in a coil, which currents are transmitted along the line for actuating the receiver. M. Maiche now uses a microphone formed of four or six diaphragms arranged in a circle, and provided with an equal number of small bells, all included in one of larger size, the office of which is to concentrate the waves and distribute them to the small bells. The diaphragms are quite small, being cut out of thin cardboard and varnished so as to be damp-proof. At the center of each of these diaphragms, and at the back, is fixed a carbon lozenge, on which rests the contact which has to produce the microphonic effects. This contact consists of a small carbon ball, suspended by a copper wire to a jointed arrangement. The core of the induction coil is formed of a magnetized bar, the armatures being iron plates serving as telephonic receivers. The current which passes through all the contacts arrives at the primary helix of this coil. The latter, in its turn, reproduces the sounds when the transmitter is not acting, and actuates the telephones of the second station when the transmitter is in action. The circuit is thus free from telephone coils, which generally render hearing difficult. A recent improvement consists in fitting the bar (as shown by the accompanying section), not to the handle but to the mouth, by means of a screwed portion which permits of adjustment so that it cannot be displaced by the deformations of the handle. The mouth itself is of cast brass nickelized; and the nut of the screwed bar is arranged on the plate which carries the coil.

Telephone Lines.

The recent concessions granted to the telephone companies by the late lamented Postmaster-General will, there can be no doubt, give rise to the provision of a large number of telephone lines. Already trunk lines are being erected between most of the large centers of commerce and their most important neighboring towns. To what extent this will continue it is impossible to say, but that there will be very large extensions of the telephone system is a conclusion at which most people will have arrived ere this.

Under these circumstances, the system to be adopted in the erection of the wires upon these trunk lines is a question of considerable importance not only to the telephone companies, but to those for whose use the wires are provided, and equally to those by whom they have to be maintained. As a rule the railway routes are in the hands of the State, acquired by it under the Telegraphs Act, 1868, and by more recent legislation. The main road routes have also been pretty well covered by the State, so that there remain but few channels open to the telegraph companies. It would, therefore, seem probable that the telephone companies will, to a great extent, be dependent upon the postal department for the provision of very many of the wires they may require either by road or railway route. Whether such should prove to be the case or not, the broad question of the system to be pursued in the erection of such lines remains to be considered.

The course hitherto adopted, and up to the present with entire success, is that known as the "twisted" system; a system which provides for a constant crossing or turning of the wires so that their relative position are frequently varied.

Although we have not noticed wires so erected, we cannot but think that were they run parallel, terminated at given distances, and crossed at those points, such a system would afford excellent results. Under the "twisted" system there are no intermediate terminations. The wires are run continuously, their position on the poles being varied as prescribed. To the lineman their appearance must be anything but gratifying. How it is possible for him to trace a given wire when faulty, especially when viewed from a railway train in motion, is a question which will probably be more easily answered by the theorist than by the practical man. The space between wires so arranged must necessarily be, at points, less than where they are maintained parallel, and this being so, the probability is that they will be subject to more faults than parallel wires. Moreover, the system is one which makes no provision for any ready changes in the relative positions of the wires. To effect such changes, the wires to be changed must first be terminated at the points selected for the crossing.

With the parallel system, with crossings at certain points—say every quarter or half mile pole—all these difficulties disappear. A proper regulation is easily secured; any irregularity is at once observable, and the lineman can readily follow out his wires. It is well worth considering whether such a system is not preferable. It would probably, to the extent of two or three shillings per mile, prove more expensive than the twisted system; but this is by no means certain, for with the parallel system, crossed at different points, the running of the wires would be more easily carried on, and it is questionable if the labor so saved would not compensate for the cost of the additional terminations. Certain it is that such a system offers to the engineer a ready means of effecting far more radical changes in the relative position of wires than any other system; a point of the utmost importance in telephone wires. Sufficient time has not elapsed to afford experience of the twisted system, either in the production of faults or difficulty of maintenance. Whatever difficulties may in this respect attach to the system, will not in all probability present themselves for some few years after the erection of the lines. It is this fact which induces us to direct attention to the subject, in order that it may be well considered by those who are interested in it, ere the erection of additional lines is taken in hand.—*London Electrical Review.*

*** Professor A. E. Dolbear says: The serious accidents which have occurred within the past four or five years through accidental contacts with wires carrying strong electric currents have seemed to call attention to the necessity of providing safeguards against such mishaps. It is probable that carelessness has been the cause of most of the accidents reported, and it is true that if weak currents only were used nobody could be hurt. It is, however, worth while to consider the electrical relations of the human body, in order to learn where danger lies. I have noted in various places the opinions of different persons as to what constituted a safe current. In one of the old books it is stated "a spark 18 in. long begins to be dangerous." In another place one says that a difference of potential of 800 volts is too high an electromotive force for individual safety. Now a difference of potential of 1,000 volts will not give a jumping spark the hundredth of an inch long. The electromotive force developed by the Holtz electro machine may be as high as 50,000 volts, and the spark from it will at most give a spasmodic jerk to the elbow and no manner of hurt come of it or of repeated shocks from it, so that more than difference of potential must be considered in determining what is dangerous about electricity. The ability of electricity to do work of any kind, destructive physiological work as well as any other, depends upon both difference of potential and current strength, and the amount of work is proportional to the time also. Now, the discharge from a Holtz machine through a short wire may give a very strong current; for example, let E=50,000 volts, R=·001 ohm, the $\frac{50,000}{001}$=50,000,000—fifty millions of amperes; but the wire may show no sign of being injured, for the time of the current passage was too short, probably less than the millionth of a second. If the discharge had continued for an appreciable part of a second the wire would have been vaporised. The discharge is probably equally quick when taken on the knuckles, but there is not enough energy to hurt anything. Again, the amount that will traverse any conductor, with a given difference of potential between its ends, will vary inversely as its resistance, and for the human body it may only roughly be calculated. The resistance of the body is very great. Many measurements, made with different individuals taking wires in their fingers and hands, gives a resistance varaying between 6,000 and 15,000 ohms; but this depends in a large degree upon the moisture of the skin when contact is made. Hands which are ordinarily dry have a high resistance; the same hands moist with perspiration or purposely wetted may lose half their resistance. Dr. Stone, of London, has made many experiments, and finds that the resistance of the body may be reduced to 500 ohms or less, by having the skin soaked. On an arc light circuit with forty lamps the difference of potentials will be about 2,000 volts. If a man with a dry, thick skin were to grasp the terminals at the dynamo, the current that would go through him would be $\frac{2000}{10000}$=·2 of an ampere, and in one second two tenths of a coulomb would have traversed his arms. If the same hands were soaked, the current might be $\frac{2000}{500}$=4 amperes, or 4 coulombs per second. In the first case there would have been spent in him an amount of energy equal to 2000×·2=400 watts, or more than half a horse-power, and in the second case 2000×4=8000 watts, or $\frac{8000}{746}$=10 horse-power in the interval of one second. Now, any electromotive force above about 1·5 volt is sufficient to decompose water, and it has been shown that the fluids of the body are better conductors of electricity than any of the tissue, even the nerves; it may fairly be inferred that such a current with such an electromotive force might decompose a notable quantity of the fluids of the body into their constituent gases. To determine the highest limit of safety would require experiments which no human beings would be willing to submit to. Animals might be employed perhaps; but if 800 volts have at any time proved to be dangerous, one may set a lower limit to the resistance of the body and determine the current strength $\frac{800}{1000}$=·8 amperes. That result looks threateningly large, but it is because the resistance is made so low. I have never found one less than 500 ohms, then $\frac{800}{5000}$=·16 ampere. But that represents 128 watts—a quantity of energy no one would care to have spent in him. After all, what would be safe for one would be entirely unsafe for another; so that each individual would have his own factor of safety, or the difference of potential which he could work with with impunity. From what we now know it would seem as if one-tenth of an ampere current body was as much as anyone could safely have traverse his body for one second. If, then, he fixes his minimum resistance, the product of the two will give him the electromotive force which he may feel timidly safe with. Thus, if one's resistance with wet hands is found to be 8000 ohms, then 8000×·1=800 volts; while if his resistance was only 1000 ohms, he could only venture to touch wires having a difference of potential of 1000×·1=100 volts. The ordinary incandescent light circuit would be on his limit.

Tubes Instead of Wires.

CITY MESSAGES TO TRAVEL HENCEFORTH UNDERGROUND.

The problem of getting the telegraph wires out of the streets of this city has been solved by the Western Union Company, which is now about ready to abolish the local wires entirely, and to connect the out-of-town wires with big underground cables. In place of the local wires, the company will use a system of pneumatic tubes, constructed, in its details, with new and simple devices that will insure a wonderful expedition for the service.

For a long time the company has forwarded messages to the *Sun* and some other Associated Press papers through brass tubes that lead from the receiving room in the top of the big building at Broadway and Dey Street, under the intervening streets, and up into the editorial rooms of the newspapers. A little more than two years ago Mr. A. Brotherhood, who has charge of all the mechanical engineering of the company, began making the drawings for the new system. The plans included the new building belonging to the company, which has since been erected on the old Peckham homestead, at the corner of Twenty-third Street and Fifth Avenue, and which was designed as a distributing office for a large territory. From the basement of this new building to the operating room in the top of the Dey Street building four lines of brass tubes, each of an interior diameter of three inches, have been laid under Broadway. Two of these tubes are for through business, and two are intended for both through and intermediate business.

To transmit a message, the operator places it in a cylindrical leather box a trifle smaller in diameter than the tube, but having flanges at each joint, which make an air-tight joint when placed in the tube. The box is large enough to hold 100 messages, if necessary. When filled, it is popped into the tube, the air is exhausted before it and pumped in behind it by engines at each end, and away it goes at a trifle over a mile a minute for ordinary working speed. If in the direct tube, the box of messages can land only at Twenty-third Street. If intended for an intermediate station, the operator there is notified, and by the time he can say "Jack Robinson" the box is before him. When the system is complete, the box will travel with equal ease and speed from any station in any part of the city to any other station.

While the general plan of sending a box through a tube by means of air pressure is old, the details of the system are both new and interesting, from the engines that furnish the power to the reversible stop-cover that snatches the flying box of messages from the tube at just the right station. There are four engines in the basement of each building, the cylinders of each being 18x36 inches, each developing about 240 horse-power, with a steam pressure of fifty pounds to the square inch and eighteen revolutions of the fly-wheel per minute. The engines act directly on the air pumps, prolongations of the piston rods working the plungers. Under ordinary circumstances, two of the engines in each building will create a vacuum in one big tank, and two will compress the air in another. But, when desired, the whole gang, or any number of them, can be used either to compress the air in one tank or to exhaust it in the other. Ordinarily, the pressure of air in the compressed tank will be 30 pounds to the square inch. Actual experiment has shown that the exhaust has produced a vacuum of 28½ inches in the other tank, or almost a perfect vacuum. The air cylinders are jacketed with spiral water tubes, the cold water entering at the end of the cylinders, where the heat generated by compression is greatest. By means of simple throttle valves worked in the operating room, either tube can be connected through heavy cast-iron pipes with either the vacuum tank or the compressed air tank. Of course, when one end of the tube connects with the vacuum tank, the opposite end will ordinarily be connected with the compressed air tank; but this is not necessary, for the boxes can be forced through the tube by either pressure or vacuum.

The messages are simply rolled up and placed in the box, a rubber strap across the open end serving to keep them from dropping out while they are being handled. The operator then swings a section of the long tube out to one side, a closed piece of pipe swinging into its place to close the tube. The box is then shoved into the open section, the receiving operator at the other end is notified, the section of open pipe is swung back into place, and the box begins to travel. The tube through which it slides is made in lengths of twenty feet. They are placed four feet and a half below the surface of the street, a location in which there is likely to be but slight variations of temperature. In the down-town portions, however, the presence of the New York Steam Heating Company's pipes has occasioned variations of 100°, making it necessary to provide for elongations and contractions of the tubes. At every 800 feet an expansion joint is placed, which allows for a change of two inches in the length of each 800 feet of tube. The greatest elongation that has taken place was due to a leak in the steam pipes, which made the tubes too hot to handle bare handed. The expansion in 800 feet of tube was one inch and three-quarters. The expansion joint is made by slipping the end of one piece of tube inside of another one that is enlarged to receive it. The inside of the end of the inner tube is ground out to form a sharp edge, which is then tempered so that nothing running through the tube is likely to get caught. Between this sharpened end and the place where the outer tube is contracted to its normal diameter there is necessarily a short space, not to exceed two inches in length, where the diameter is so great that the air can shoot past the flange of the passing box; but as the box is as long as a common message blank, there is always one flange in the tube where the diameter is normal. The whole joint is enclosed in and held in place by air-tight collars, the details of which could not be explained without drawings. Where the common joints are made, the ends of the pipe are enlarged, so that a lengthwise section of the two ends, when placed together, would make a very flat V. The ends are surrounded by iron collars, a flange on the face of one projecting into a groove in the face of the other, where it pressed against air-tight packing. They are held in place by two rings connected by longitudinal bolts.

To reach the way stations along the line, the way tubes curve out of the street and up into the operating room of the station. When a box is to be sent on a way station, the operator is notified by an electric alarm. He at once swings a section of the tube before him to one side, and swings another section, having a glass face on one side and a wire screen at one end, into its place. The screen stops the box, and the operator can see it before him. He swings it out, and the other part of the tube is thereby swung into place, so that other boxes intended for other stations pass on.

Every 400 feet along the line of tubes is a man-hole in the street, by which workmen can get down to examine the tubes. Leaks or cracks in the tubes are located by sending a box through at the end of a strong line.

When the system is complete the present offices of the city will constitute way or central stations on the pneumatic railway. The capacity of a tube is about 1,000 messages, or ten boxes a minute. The size of a box is such that packages of merchandise of considerable size can be sent as well as messages. It will cost no more to send a boxful of messages from one end of the city to the other than to send a single message of three words, a circumstance that is likely to be of great interest to the other telegraph companies who will continue to use the wire. The officers will not tell what the plant has cost, but the bare tubing is worth $1 a foot, and 70,000 feet are in use between Twenty-third and Dey streets. The couplings bring the cost of the four tubes to more than $100,000. In addition there are the eight engines and their air pumps and compressers, and the expense of putting the whole plant in place. The present plans are expected to furnish a plant to last for twenty years. What may come after is an interesting question.

Mr. D. J. Ludwig, who has been at the head of the Western Union news department for many years, has left that company, with several of his assistants and valuable employees, to take charge of a commercial news bureau for the Baltimore & Ohio. President Bates says, "We are going into the business of furnishing market quotations as fully and as rapidly as possible. A supply of tickers is being manufactured for us, and will be started soon. Our wires are all working, and we are handling unusually heavy business."

.... C. and E. Fein, of Stuttgart, have undertaken a series of trials with one of their 1 C double-current dynamos, as regards the application to telegraphy of this machine worked by hand, but with the intercalation of artificial resistances. The results of these trials, in which the dynamo was driven, not by hand but by a motor, which its strong construction permits, are given in the following table:

Machine.			Morse Instrument.	
Revolutions per min.	Resist. Ohm.	Current. Amp.	Resist. Ohm.	E.M F. Volt.
2,000	3.5	3	5,000	35
2,480	3.5	3.5	6,000	45
2,990	3.5	4.5	7,000	52
2,100	2	5	6,000	44
2,500	2	6.5	7,000	51
3,010	2	7.8	8,000	60
2,020	1	8	8,000	57
2,475	1	10	9,000	65
3,060	1	11.7	10,000	72

The Morse instrument, the electro-magnet of which had a resistance of 120 ohms, worked perfectly well under the above-named condition.

.... A referee in the suit of Alexander H. De Haven, a stockholder, against the Bankers and Merchants' Telegraph Company and its receivers, who were appointed in the sequestration suit brought by Austin G. Day, a judgment creditor of the company, Thomas S. Moore reported last week that the receivers should be allowed to issue $1,500,000 of certificates, which should be a first lien on the company's property, and the proceeds of which should be used in settling all claims against the company excepting those of the holders of its mortgage bonds. In his report, Referee Moore stated that the Bankers and Merchants' Company had in its treasury $99,000 of the bonds under the mortgage of $10,000,000 given by it to the Farmers' Loan and Trust Company; $5,115,000 of them were in the hands of purchasers, and $4,786,000 of them were pledged as security for its notes representing $784,874.18. Besides the notes last mentioned, the company owed $372,209.37 to unsecured creditors for work and material; $145 000 on coupons of bonds of the Southern, Trade, and American Rapid Companies which corporations it controls; $200,000 on bonds issued under a mortgage of the New York and Washington line; $8,700 as interest on those bonds; $4,800 for taxes; $130,000 on receivers' certificates, issued to enable the receivers to get possession of certain western branch lines; and $97,000 borrowed money, for which the receivers are yet to issue certificates. The $130,000 of certificates were made special liens on the property they were issued for. Referee Moore also reported that if the gap between Hammondsport, Ill., and Chicago, and that between Meridian, Miss., and New Orleans were closed, as they could be readily and cheaply, as the material for the connecting lines was on the ground, the business of the company would be greatly benefited. In Referee Moore's opinion, receivers' certificates, if made a first lien on the property of the company, could be sold for par, or not less than 90, and that the proceeds of the sale of $1,500,000 could be made to redeem every liability of the company, excepting the bonds issued under the $10,000,000 mortgage. Judge Donohue has made an interlocutory decree re-appointing Messrs. Newcomb and Smith as receivers of the company, and authorizing them to issue the certificates representing $1,500,000.

TELEGRAPHIC

.... A telegram dated Alexandria, December 8th, states that the Inspector-General of telegraph has succeeded in stringing a line, composed of three steel wires, across the Nile at Assouan. The wires are suspended from masts, placed on the mountains, on each side of the cataracts. The distance between the two masts is 7,000 feet.

.... The Engineer of the company, Mr. Robert Gray, telegraphs under date of December 8th, announcing that the cable of the Spanish National Telegraph Company, between Teneriffe and the colony of Senegal is laid. The latter colony is thus placed in communication with Europe by the cable of the same company between Teneriffe and Cadiz.

.... The new cable laid by the India-Rubber, Gutta-Percha and Telegraph Works Company, between St. Vincent and Santiago, was opened to the public on November 20th. The same company proposes to lay cables between Santiago and the West Coast of Africa, which will place the Portuguese and other colonies in telegraphic communication with Europe.

.... Delays happening to telegrams between London and Greenock, have for some time past been the cause of numerous complaints from private business houses and from the press. In order to remedy this defect in the service, the Post-Office will place a direct special wire at the service of the London and Greenock business, which will, it is hoped, remedy the evil complained of.

.... The announcement of lower rates on the Baltimore and Ohio telegraph lines is followed by a reduction by the Mutual Union Company in rates from New York as follows: To Chicago, 15 cents; to St. Louis, Cincinnati, and intermediate points, 20 cents; to all offices in Massachusetts, Rhode Island, and Connecticut, and to Philadelphia, Baltimore, and Washington 10 cents. The rates by the Mutual Union lines to all points West, to and including St. Louis and Chicago, has been but 20 cents since July 1. Western Union announces no reduction.

.... The remaining portion of the new story of the Post-Office building, London, was occupied last week by the telegraphic staff. There are altogether 381 circuits, connecting the main office with city and suburban offices. These circuits are in operation from eight in the morning to eight o'clock at night, with a staff of 500 employes, most of whom are women. The 351 out of-town circuits are provided for in the third story, and in a few months the basement will be fitted up with pneumatic tubes. The two top storeys will contain only machinery and the repair shops.

.... The Western Union Telegraph Company in Boston, laid through their conduit on State Street, a Kerite cable of sixty conductors, containing nearly eight miles of wire. This cable is one of the largest, if not the largest ever placed underground in this country, was handled successfully and placed in the conduit without difficulty, by Mr. E. B. McClees, who has charge of the outside and ground work for Mr. C. B. Hotchkiss, the General Agent for Day's Kerite. Powerful winches were used to draw it in, and the time occupied from the hour it was brought upon the ground, until each conductor was tested out electrically and numbered from the office to the other terminal was about six hours. The order for the cable received about the 12th of the month, and the cable was made, shipped, and in place on Dec. 30th, another evidence of the promptness and facilities of the Kerite people. One of the advantages in these cables is the taping or braiding of one wire in each course or layer of the wires in the cable, called a tracing wire. By starting with the tracing wire and counting to the right or left as the case may be a wire at one end of the cable may be readily found by its relative position to this marked or tracing wire at the other end.

(*Continued from Fifth Page.*)

devoted himself exclusively to electric lighting, having been in the employ of the Joel-Pilsen Company in England. He is a practical man as well as a theoretical one, thoroughly informed as to all that is going on in the world of electricity, and amply equipped for his work. I saw the company's new arc lamp, though only in experimental operation. It is a positive feed lamp, and seems to work with great regularity, giving an excellent light. I was chiefly interested in the incandescent department. Mr. Pfannkuche has devised a novel form of dynamo, the first of which I saw in operation, although under unfavorable conditions. It certainly did very creditable work, both as to quantity and quality. The lamps are made on the premises, and the whole process, except that of making the filaments, of which cotton thread is the basis, was shown me. I saw a hundred and more of the lamps on a testing frame at once, and was greatly pleased with them. Believing that there is a big field for incandescent lighting yet undeveloped in this country, especially from isolated plants, I am always glad to see any indications of progress. I understand that the Schuyler Company is putting in a number of such plants, and that it guarantees ten standard lamps—16 candle-power—per horse-power, and an average life of one thousand hours for its lamps. If it can do this, I am quite certain that it need but make the fact known to have all the business it can attend to in its incandescent department, without troubling itself at all concerning arc lights. By the way, it has an arc plant of eighty lights at Holyoke, and I learn from persons who have seen it that it is working very satisfactorily indeed.

When I left Hartford early in the evening, the music of the dispersing military bands was filling the air. The great event was over, the Governor had been duly inaugurated, the cannon had boomed, the "sounding brass" had given forth its martial notes, the drum major had twirled his big-headed cane, and everybody was happy. There was to be a ball in the evening, but I did not stay for it. Fact is, I wasn't asked. Going down to New Haven in the train, I sat with Mr. Gilbert, president of the New Haven Electric Company, which runs a 150-light Thomson-Houston plant in the Elm City. It is doing a splendid business, paying two per cent. every quarter, and laying aside as much more for surplus. It has one of the neatest and best-arranged stations I ever saw, and its lights are all within a comparatively short distance of the station. Mr. English is the secretary, and he and Mr. Gilbert give the business their close personal attention. Room has been provided for enlargement, and an addition of another fifty lights has already been decided upon. The substantial way in which the three Armington & Sims' engines in use have been set deserves mention. They run as smooth as oil, and without the least perceptible jar. Good, solid foundations contribute very much towards making an engine do good work, and towards preventing wear and tear. Go to hard pan if you want something solid for your engines to rest on, and then build broadly and substantially. The New Haven folks are very proud of their Electric Light Company, of its success and of its light, and it is my opinion that, before another year comes round, two thundred and fifty or three hundred lights will not be more than enough to supply the demand, especially as there is likely to be a loud call for it for street lighting.

I am not sure that Mr. H P. Frost has not missed his calling. He ought to have been a professional newspaper interviewer. He can ask more pertinent questions in five minutes than any man I ever saw. I answered a few, just to start things, and then I shut down, remarking that I came to *get* news. The Southern New England is doing excellently well. It has a lot of good, paying exchanges. Its trunk line business is in good shape. It has taken the copper circuit in hand, and, although things go a little slow at first, and subscribers are a little shy of the rates charged, the prospects are that this branch of the business will be both large and remunerative.

Mr. Frost took me round to the exchange, and introduced me to the manager, Mr. Fairchild. His room comes as near to being what an exchange room ought to be, a parlor, as anything that I have seen. It strikes one as a somewhat noisy exchange, but this grows out of two facts—first, the trunk line board is in the same room, and, second, the young ladies call across from one board to the other to give the name of the party wanted. Unless the whole theory of the telephone is erroneous, loud talking is no more necessary over a long line than over a short one, provided the line and instruments are in order. It is the *transmitter* you are talking to, not the party at the other end of the line. The young ladies in Mr. Fairchild's exchange have pleasant voices—"an excellent thing in woman"—and their chatter is, on the whole, merry and musical, but it is not exactly business-like.

I talked with Mr. Fairchild about the neatness and attractiveness of his room, and found that he was thoroughly in accord with my ideas on that subject. Make the room pleasant, neat and comfortable, and you make it attractive to the very best and most intelligent class of young ladies as operators. They have an arc lamp in the room for afternoon and evening use, which gives an abundance of light, but is sometimes a little unsteady, and therefore trying to the eyes. An incandescent light over each board is the thing wanted. Mr. Fairchild has but one fault to find with his corps of assistants. They will marry. He does all he can to prevent it, keeps the door bolted, and does all he can to fight the young men off. But they get the better of him now and again. It is the way of the world.

When you go to see Mr. Frost, get him to "hitch up" and drive you to the top of "High Rock." You'll have a delightful time, good company, and see as fine a sight as is to be found out-doors. Don't forget this.

I noticed at one of the exchanges which I visited on this trip, I forget which, that the operators' telephones hung from a projecting rod by a short chain. When in use, they are held to the ear. When not in use, they let them dangle. I asked why they did not use a holder, keeping the instrument in just the right place for the ear, thus relieving the operator from holding it, and was told that, while that would do through the day, it would be inconvenient at night, when the operator wanted to answer calls at the several boards without sitting down. I beg modestly to suggest that the holder might be so arranged, by means of a clip, as to hold the telephone during the day, and that it might be taken out of the clip at night, and allowed to "dangle" from the same holder by means of a short chain during the night. I am not sure that I ever saw this done. Perhaps I evolved it out of my inner consciousness. At all events, does not the idea cover the ground?

The superintendents of the different divisions of the New England Telephone and Telegraph Company (some fifteen in number) assembled at the offices of the company, 50 Pearl Street, Boston, last Tuesday, by invitation of the management. It was the desire of the management to bring the gentlemen together for the purpose of discussing important matters relating to the business of the company, and there is no doubt that the meeting and the comparing of notes will result in practical benefit to the company and men. They remained in Boston Tuesday and Wednesday. Messrs. Ingham (vice-president), Keller (acting general manager), and Wheeler (general superintendent) made valuable suggestions. Tuesday evening the men were provided with tickets to the Electrical Exhibition (through the courtesy of Col. Parker, superintendent of Boston division), and Wednesday evening, after being photographed in a group, left for their respective headquarters, much pleased and benefited by their visit. It is understood to be the intention of the company to have these visits occur every six months. Let the good work go on.

Mr. Chas. T. Loring writes me from Boston, calling attention to an error in what I said last week about charging for address and signature in England. My only excuse is that I based my statement on my own experience in Europe "a many years ago" Mr. Loring says: "The rates throughout England and Ireland are 20 words for one shilling, or twenty-four cents. The address of sender and receiver are not counted nor charged for. Of course in cablegrams they are. In Paris there are two kinds of telegrams, one the "Carte Telegram," which is similar to our postal cards, where you can write all you want, and leave in the telegraph office and it will be forwarded through pneumatic tubes to the nearest office for which the address calls. The cost of this card is 50 centimes, or 10 cents. The addresses and signatures of telegrams which are sent outside of the city are sent free, and it is the same in most of the large cities such as Berlin, Venice, and Rome.

An Absolute Standard of Light.

It will be remembered that during the Paris Electrical Exhibition of 1881, M. Violle suggested as a standard the light radiated by a square centimeter of platinum at the fusing point, or in other words, at its point of solidification. The Congress which then sat recommended the Carcel lamp, of the Dumas and Regnault type, as a secondary standard, and the international Conference has now definitely adopted the Violle light as the primary standard. M. Violle has since determined the value of the Carcel lamp in terms of his proposed standard. By different methods he finds the normal value of the Carcel "bec" is $\frac{1}{8 \cdot 07}$ of the platinum standard; and, surface for surface, the intrinsic light of the latter is about eleven times greater than that of the Carcel flame. M. Violle has also compared his standard with electric incandescent lamps, which from their color and constancy are easily compared with the platinum light. A Swan incandescence lamp was fed by thirty Kabath accumulators; a resistance box being inserted in circuit to regulate the current. Every minute an observer noted the current strength *i*, and the fall of potential between the terminal *e*, and the photometric values of the light were also determined. Comparison between the electric lamp and standard was effected by means of a Bunsen photometer having a range of 4 meters.—*Engineering.*

---

* * M. Niaudet has recently been experimenting with some success on the reduction of chloride of sodium or common salt into its components, chlorine and sodium, by means of the electric current; and as both of these products are very valuable, the former for bleaching the latter for chemical purposes, it is to be hoped that his further experiments will be crowned with perfect success. Mr. Sommer, a Californian electrician, has also devised a method of reducing lead from its ores by electrolysis. Salts of lead in solution submitted to the electric current yield a deposit of lead on the negative electrode and peroxide on the positive electrode. Mr. Sommer arranges to amalgamate the lead before it oxydizes or deposits. His process consists in placing a layer of mercury in a glass test tube (20 to 40 grammes), then a quantity of dilute chlorhydric acid (15 to 20 per cent. of H. C. L.). Into the tube is then placed a gramme of lead ore pulverized, which falls to the surface of the mercury. An electrode of lamp carbon is then dipped into the mercury, and one of graphite into the acid. The current of four Daniell or Meidinger or two Bunsen or Grove elements passed through the combination while the test tube is kept at 70 deg. Cent., serves to effect the reduction. Sulphuretted hydrogen is disengaged at the negative pole, and hypochlorous acid at the positive pole. At the end of five hours the reduction is complete, and the mercury being taken out, washed, and weighed, shows that the lead has been amalgamated. It is necessary to have the positive electrode of graphite and the negative of lamp carbon.

---

* * M. D. Thommasi, in *Kosmos*, says the expression, quantity of electricity, which recurs in practice as well as in theory is not always understood, and requires more explicit definition, so as to avoid all misconception. It is specially in electrolysis that the "quantity of electricity" plays an important part, and with it the expressions "electrical equivalent" and "electro chemical equivalents." Reference to the tables contained in electrical treatises show that to liberate, for instance, 4·05 grammes of silver requires a current of 1 amp.-hour absolutely, as in the case to liberate 1·05 gramme of iron, 1·19 gramme of copper, 1·11 gramme of nickel, etc. This, continues Mr. Thommasi, is perfectly correct, provided that in each case the number of volts accompanying the amp.-hour correspond with the quantity of heat absorbed by the decomposition of the electrolyte. This E.M.F. acquired, the metallic deposit will take place in proportion to the intensity of the current. When "electrical equivalent" is used to mean the quantity of electricity necessary to decompose a molecule of any substance whatever, it is evident that intensity of current and not E.M.F is meant. It follows that this expression, which relates to only one of the factors of energy, seems to refer to the product itself—that is to say, to the electrical energy. To avoid this confusion, it would be well to complete the tables of electro-chemical equivalents by an indication of the *calories* of combination expressed in volts of each compound. In this way, it would be known that, for an amp.-hour to decompose 2·98 grammes of sulphate of copper, 3·02 grammes of sulphate of zinc, etc., it will be necessary that the current have at least an E.M.F. equal to 1·4 volt for the sulphate of copper, and an E.M.F. equal to 3·46 volts for the sulphate of zinc.

---

* * In the case of Lawless *vs.* Pyne, in London, a motion was made last week before Mr. Justice Kay, by Mr. Northmore Lawrence, on behalf of the plaintiff, for an injunction to restrain the defendants from allowing the Great Eastern, which is now at Milford Haven, from proceeding to New Orleans under a charter party to the defendant. The defendant is the American agent of the World's Industrial Cotton Centennial Exposition to be held at New Orleans. The plaintiff had thought of chartering the Great Eastern for the exhibition at New Orleans at a quarter a dollar per head, and letting out for balls at half a dollar per head, and intended to form a syndicate for the purpose. He entered into negotiations with the secretary of the Great Eastern Steamship Company to charter the ship, and to pay for her £6,000 or £7,000 during the exposition, with the option of purchasing her for £45,000 at the termination. He failed to form the syndicate. The defendant, who was then in this country, but was now in America, formed a syndicate, and chartered the vessel for £7,500, and the ship was now about to leave under the charter party. The plaintiff sought to restrain the vessel from sailing on the ground that he had virtually chartered her. Mr. Justice Kay, without calling on the defendants, held that there was no evidence that the plaintiff had ever made any definite arrangement, or that his terms had been conclusively accepted by the Great Eastern Company. The defendant had, however, chartered the vessel. The motion must therefore be dismissed with costs.—*Electrician.*

---

* * At a recent meeting of the Mining Institute of Scotland, a paper was read by Mr. Robert Thomas Moore, C.E., B.Sc., entitled "Notes on Some Saxon Collieries." One of the mines visited by the author during the past autumn was the Zaukerode Colliery, at Plauen, near Dresden, which belongs to the Government. As a special feature of the

appliances in use at this colliery, the author remarked that there is one of Siemens and Halske's electrical locomotives drawing coals along one of the underground roadways over a distance of some 700 yards. Driven by belting from a small vertical engine having its cylinder inverted, and with its pulleys about three to one, there is on the surface the primary dynamo machinery, which is run at about 600 revolutions per minute, while the engine has a speed of about 200 revolutions per minute. The current from the dynamo is carried down the pit shaft, which is about 120 fathoms deep, by means of ¼-inch copper rods, and along the level roadway it is conveyed by means of two rails of T-section, which are fastened to the roof of the mine. The road, which is a cross-cut mine for getting over a fault, is laid with a double line of rails, and is arched with brick throughout its whole extent. Porcelain insulators are fixed in the brickwork for carrying the conductors. There is a secondary dynamo on the locomotive, which is connected to the wheels of the latter by means of gearing. Each pole of the dynamo communicates with one of the conductors on the roof by means of a covered wire, one end of which is fastened to a carriage running on the rail, and the other to a pole of the dynamo. The "race" consisted of 15 tubs, each containing 10 cwt., and when loaded weighing 15 cwt. The locomotive was put behind the "race" and ran the whole length of the drift in four minutes, or at the rate of about seven miles an hour. It was making 25 runs per day, and drawing about 200 tons in that period. Mr. Moore learned that the following was the proportion of useful effect of the arrangement: Steam engine, 10 horse-power, and the dynamo and locomotive, respectively, 5 and 3 horse-power, from which it was concluded that 30 per cent. of the power of the steam engine was got out of the locomotive. The cost of the whole erection at the colliery was about £900, and the system has been in operation for nearly two years, the engine working very satisfactorily, giving no trouble, and the working expenses being very low. As the cost of repairs was almost *nil*, the chief expenses consisted of the wages of the enginemen on the surface and on the locomotive.

** Herr Boher, illumination inspector of Dresden, has been making some experiments to determine what part is played by electricity in causing explosions of flour dust in mills. His investigations have been conducted at the Royal Court Theatre, where the powerful dynamos for the electric lights are driven by steam power. "Here," the inspector says, "the electricity from the belting is so intense that more could scarcely be obtained in the best electric machines. Leyden jars became charged by this means in a few seconds, so that, on being discharged, sparks leap one and three-fifths inches. Any person standing on an insulator, and placing the hand within four to six inches of the moving belts, is quickly charged with electricity, so as to give out long sparks. Geissler tubes, having projecting pointed wire at one end, and metallic connection with the earth at the other end, glowed, when placed near the belts, with beautifully colored lights. In short, every experiment possible with electric machines can be performed by this belt-developed electricity. At first I thought that the presence of the dynamo-electric machines had a great influence on this phenomenon, but I have noticed the same, more or less shown, in many kinds of factories having steam power. In many flour and meal mills the dust has become ignited without the cause having been discovered. I have now, from experiments, become firmly convinced that electricity developed by belts can cause such disaster. In most factories, other than flour mills, the quantity of metal present, and the arrangement of the iron-framed machines, is such that a connection among them is established sufficient to conduct safely away the electricity. It is, however, different in flour mills, especially where French burr stones are used, which are made of separate pieces bound together by thickir on bands. The latter are not connected with one another, but isolated by the non-conducting stone. Rims, therefore, which are next to the driving pulleys and belts (generally located just below stones when cogwheels are not used, and pulleys almost equal in diameter to the stones) become surcharged with positive electricity, as shown in the Leyden jar, for instance; the next nearest rim or rims will, by induction, develop negative electricity. These opposite forms of force having arrived at a dangerous degree of tension, the leaping of an intense spark from one stone band to another could ignite the exces-ively inflammable flour dust. To guard against this danger, it is simply needful to collect the iron spindles of the stones together by a thick wire, a metallic bar being at the same time located nearly touching both stone rim and driving pulley. In all other industrial works the precaution would be advisable that no isolated ironwork should be near pulleys and belting when combustible materials are also in the immediate neighborhood." The editor of the *Scientific American*, commenting on the remedy above suggested, fears it is of little avail, as the connection of the spindles as proposed will not prevent the generation of electric sparks, and remarks that a better prevention is to keep the atmosphere of the apartments where the belts run thoroughly damp.

** The revival of the primary battery for electric light purposes has brought about some discussion as to the actual electromotive force of batteries, and its value as calculated by thermo-chemical formulæ. Some batteries have an actual electromotive force considerably at variance with the theoretical value as calculated. A note by M. Chaperon, recently presented to the French Academy of Sciences, is designed to throw some light upon this question. Edmund Becquerel pointed out in 1856 that couples containing iron, nickel, or cobalt, in a solution of potash, show remarkable differences of this kind. So do elements having magnesium in a potash solution, or aluminium in dilute sulphuric acid. A cell consisting of aluminium, dilute sulphuric acid, sulphate of copper, copper, gives 0 62 volts, whereas the theoretic value is 2.06 volts. In the same way a magnesium-platinum couple in potash, contrary to the theory, is less energetic than a zinc platinum couple in the same liquid, and gives 1.35 volts instead of 1.43 volts. Polarization is commonly believed to be a cause of this discrepancy, and M. Chaperon has made some interesting researches on the subject. His method was to obtain curves of the electromotive force of a cell by charging a condenser from it at intervals by means of a rapid working key. The curves show that the metals studied give, with the electrolytes in which they were examined, polarisable systems until the decomposition of the electrolyte into its elements, the difference of potential retained by the electrodes growing, after a continuously law, between zero and the point of electrolysis, and even beyond it. The limit of electromotive force thus obtained after apparent electrolysis is often superior to that given by platinum. Thus with magnesium in the alkalies the electromotive force restored was 3.8 volts; with aluminium in acidulated water it was over 4 volts. To express the ratios between polarization and the anomaly of static electromotive force, let $T_{m\,R}$, $T_{m\,H}$ be the electric energy corresponding, at a given temperature and pressure, to the absorption or restitution of elements R and H of an electrolyte by a polarizable metal electrode m. $T_{m\,R}$ and $T_{m\,H}$ are constants, but vary, on the contrary, between very wide limits. The chemical work corresponding to the electric energy restored by two polarized electrodes is in general:

$$T_{R\,H}-T_{m\,R}-T_{m\,H}$$

$T_{R\,H}$ being in given conditions the energy of formation of the electrolyte; $T_{m\,R}$, $T_{m\,H}$ having values which correspond to two states of saturation of electrodes. If the polarization follows a continuous law, as in the cases studied, this value for chemical energy varies from $T_{R\,H}$ at zero between the point of electrolysis and the neutral state of the electrodes. Then

$$T_{R\,H}-T_{m\,R}-T_{m\,H}=0 \quad . \quad (1)$$

In the same interval, $T_{m\,R}$ and $T_{m\,H}$ vary from zero to two positive values; each of these values being at the limit, smaller than $T_{(R\,H)}$. It is the limiting value of $T_{m\,R}$ satisfying to the equation (1) which enters into the calculation of theoretic electromotive forces instead of the heat of combination. Equation (1) is evident if we consider it as expressing the fact that the metal does not disengage electric energy or work in decomposing the electrolyte of itself.

** It is claimed that one of the recent electric batteries acts only when exposed to light. The latest form of battery—devised by Mons. Jablochkoff, the eminent French electrician—is perhaps quite as novel and ingenious, it being kept in constant operation by the effect of the atmosphere's moisture upon the metal sodium. Each element comprises a small plate of sodium separated by wooden pegs from a plate of carbon of somewhat lighter texture than that used for ordinary batteries. The carbon and a small copper wire attached to the sodium plate form the electrodes. Exposure of the sodium to the air causes it to oxidize and form caustic soda, which is dissolved by the moisture of the air and gradually drains away as a concentrated solution, thus constantly leaving a fresh surface of metal to be acted upon. The elements are grouped in sets of ten. The battery's action continues so long as the sodium lasts and the air contains moisture, and the only means of stopping it is to shut it in an air-tight case. The degree of the air's humidity and the temperature determine the electro-motive force.

** It may be a matter of interest to visitors and officers of the Exposition at New Orleans to know that a time ball has been erected on the central tower of the main building, which will be dropped at 10 A.M., "central time," each day. This will give a daily sign, visible from all parts of the grounds, by means of which all clocks can be corrected. The ball is dropped from the observatory of Washington University, St. Louis, the signal which does the dropping being given by the standard clock at St. Louis, 700 miles away. The ball has been erected through Maj. Hilder, Commissioner for Missouri, by Prof. Pritchett, director of the observatory, and his assistant, Mr. Ramel. The Washington University observatory serves as a time center for most of the railways of the Mississippi Valley, and daily sends out signals over a larger area than any other observatory in the world, and over more miles of railroad, with the possible exception of the Royal Observatory at Greenwich, England. These signals go as far east as Pittsburgh, as far West as Denver, and from Chicago on the north to New Orleans and Mexico on the south. They are received daily on 50,500 miles of wire in this large area, and have been received in New Orleans for some years on the Western Union and railway wires. The project of utilizing them at the Exposition involved only the work of extending them from the Western Union office to the Exposition building, which has been done through the courtesy of the university and of the Western Union. The signals which do the dropping come over the wires of the Missouri Pacific Railway, the electric connections for their transmission having been carefully arranged by Superintendent Hammond, of the Missouri Pacific, the details of the work here being under the immediate direction of Mr. Littlefield, superintendent of the Texas Pacific and International and Great Northern Division. The time ball and the ingenious apparatus by means of which a clock 700 miles away is enabled to drop it, will be open for the inspection of visitors who care to climb to the top of the tower. The ball will be raised to the top of the mast at 9:55 o'clock, and exactly at 10 will fall. Besides dropping the time ball, the same signals will be used to correct clocks in various parts of the building, and will also be received on telegraph sounders in the same manner as at the various railway stations.

** The Parisians have just had the opportunity of seeing a tricycle worked by electricity.

ELECTRIC LIGHT NEWS

—— The provisional directors of the Halifax Electric Light Co., held a meeting at their office, No. 15 Duke Street, on the 6th, and, having obtained their charter from the provincial government, and also authority from the municipality to erect poles and string wires, it was voted to commence operations immediately. The contract for a 100-light Thomson-Houston plant was awarded to the Royal Electric Company, of Montreal, some months since, and Mr. M. Lee Ross, one of the managers, is now in the city completing the work. The station is equipped with two 50 horse-power engines, one 125 horse-power boiler, four 25-light dynamo machines, and all requisites for a complete 100-light plant. The company is capitalized for $80,000, and the following gentlemen are its directors: Robie Uniacke, president Halifax Bank; Jas. Thomson, director Halifax Bank; Jas. Bayne, director Halifax Bank; R. F. Worral, capitalist; M. Lee Ross, manager Royal Electric Company.

** Mr. J. O. Shiras, of Cincinnati, says that the Cincinnati Electrical Society has ended the first year of its existence with good results, and there seems to be a future of prosperity opening before it.

** The large number of people who attend the Boston Electrical Exhibition now is really a proof that New England people are always ready to patronize an institution that has for its object the education of the people, as well as to cater for healthful and proper amusement. The exhibition is visited by the best class of people, and many prominent men have made repeated inspections of the wonderful things displayed. Mr. M. J. Gaines, the superintendent of the Anglo-American Cable Company, has promised to come to Boston again and deliver at the exhibition a lecture on the making and laying of transatlantic cables.

** A memoir by M. F F. Le Roux, on an experimental demonstration of the inversion of the electromotor force produced by the contact of iron and copper at a high temperature, has been submitted to the Academy of Sciences, Paris. From the results of several experiments, conducted under varying conditions, M. Le Roux concludes that at about the temperature of 1,000° centigrade an electric current passing from the copper to the iron heats the point of contact, while cooling it at the ordinary temperature. A knowledge of this fact, now for the first time demonstrated, may, it has been anticipated, affect not only the theory of thermo-electricity, but also that of certain chemical phenomena.

** Helmholtz has demonstrated analytically, and Czapski has verified experimentally, the following fact, recently brought before the Paris Academy by M. Lippmann: Certain galvanic elements have an electromotive force variable with the temperature, and also this remarkable property, that the energy which they manifest in the form of current is not equal to the energy of the chemical action measured by the calorimeter. The difference between the two quantities is due to the fact that the heat borrowed from the surrounding atmosphere is added to the chemical heat, to be transformed at the same time into electrical or mechanical energy. M. Lippmann, in seeking what battery elements have an electromotive force variable with the temperature, has found that those are constant which satisfy the law of Kopp and Woestyne. Connecting this fact with M. Berthelot's former discovery, he arrives at the conclusion that, if the law of calorific capacities be verified, the chemical heat and electromotive force are equal, and also independent of the temperature. In the contrary case, the values of these properties become unequal and variable with the temperature.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JANUARY 6, 1884.

310,177 Binder for electrical conductors; James Brady. Brooklyn, N. Y.

310,252 Apparatus for measuring electricity; Jules Cauderay, Lausanne. Switzerland.

310,258 Manufacture of telegraph conductors; Alfred A. Cowles, New York, N. Y., assignor to the Ansonia Brass and Copper Company, Ansonia, Conn.

310,282 Telephone system; William A. Jackson and William R. Cole, Detroit, Mich., assignors to the Western Electric Company, Chicago, Ill.

310,373 Holder for incandescent lamps; Thos. W. Bryant, Ansonia, Conn.

310,379 Telephone signaling apparatus; James H. Cary, Boston, Mass., assignor to the Cary Telephone Signal Company, Portland, Me.

310,412 Visual electric signal; Frank M. Godfrey, Congdon, Neb.

310,472 Thermal cut-out; Wm. Stanley, Jr., Englewood, N. J.

310,516 Incandescent electric lamp; Charles A. Hussey, New York, N. Y., assignor to the Hussey Electric Light and Power Company, same place.

310,530 Electric pneumatic clock system; Chas. A. Mayrhofer, Vienna, Austria-Hungary, assignor of one-half to Carl Diener, same place.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40.00. Various other Foreign patents may also be obtained.

OKONITE

NEW YORK INSULATED WIRE AND VULCANITE CO.,

13 Park Row, New York.

Hard Rubber for ELECTRICAL PURPOSE.

WANTED.

An experienced Telephone Man of ability. Address "SOUTH."
Care of Electrical Review,
23 Park Row, New York.

ELECTRIC LIGHT

REES & KITSON,

730 Sansom St., Philadelphia, Pa.,

Undertake the furnishing and erection of Electric Light Plants of every system. Incandescent Wiring and Repairs to Dynamos and Lamps a specialty.
Estimates furnished on application.

CONNOLLY BROS.,

Patent Attorneys

AND SOLICITORS,

MORSE BUILDING,

Cor. Nassau & Beekman Streets,

NEW YORK.

PHILADELPHIA, PA.,

Mutual Life Insurance Building,

10th AND CHESTNUT STREETS.

WASHINGTON, D. C.

CORNER 6th and F STREETS.

ELECTRICAL CASES A SPECIALTY.

THE

CALLENDER INSULATING AND WATERPROOFING COMPANY

Factory, EAST NEWARK, New Jersey.

Office, 7 NASSAU ST., New York.

New England Ag'cy, THE ELECTRICAL DEVELOPMENT & MANUF'G CO. 197 Congress St., Boston.

Electrical Engineers.

MANUFACTURERS of BITITE Insulated Wires and Cables for UNDERGROUND, OVERHEAD and SUBMARINE purposes. Anti-Induction TELEPHONE CABLES, (1 to 50 Conductors) &c.

CONTRACTORS for Supplying and Laying UNDERGROUND WIRES for all purposes.—FOR ESTIMATES &c. APPLY TO

W. M. CALLENDER, SECRETARY,

7 Nassau Street, New York.

Rhode Island Telephone and Electric Company.

30 & 31 BUTLER EXCHANGE,

PROVIDENCE, R. I.

MANUFACTURERS OF THE

Providence Telephone Switchboard

Breckenridge Jack, Wright Cable Clip

HOWARD SAFETY APPLIANCE

for protection to telephone subscribers against lightning or electric light currents.

LICENSEES of the Time Telegraph Company for the New England States.

DEALERS in Electrical Appliances of all descriptions.

MANUFACTURERS AND CONSTRUCTORS of Lightning Rods upon scientific principles

Correspondence solicited from inventors or parties having electrical novelties, with a view to purchase or introduction. Assistance furnished to those desiring to patent or develop electrical novelties.

OFFICERS:

HENRY HOWARD, President.
J. W. DUXBURY, Sec'y & Gen'l Manager.
CHARLES T. HOWARD, Treas.
F. H. GARDINER, Ass't Manager.

THE

Electrical Review

Is an ILLUSTRATED

WEEKLY JOURNAL

—OF—

Electric Light, Telephone, Telegraph

—AND—

SCIENTIFIC PROGRESS.

Each edition will contain original articles on the latest applications of electricity, and a complete record of the progress made from day to day in the Telephone, Telegraph and Electric Light fields.

TERMS OF SUBSCRIPTION.

In the United States and Canada, $3.00 per annum—postage free.

To foreign countries the subscription price, prepaid, is $4.00.

The *Electrical Review* with copy of *Electrician* and *Electrical Engineer*, $5.00 per annum.

Electrical Review Publishing Co.,

Box 3329. 23 PARK ROW, NEW YORK.

WANTED.

Second-hand bridge or coils cheap. I would like to meet some one as companion or teacher in the study of electricity living not far from City Hall, Brooklyn. Address, J. P. W.,
Care R. EASSON, 54 Pine Street, New York.

PAINE & LADD,

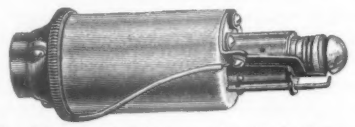
HALBERT E. PAINE, Late Commissioner of Patents. | STORY B. LADD.

Attorneys in Patent Causes And Solicitors of Patents.

WASHINGTON, D. C.

The Connecticut District Telegraph & Electric Co.

General Agents for



The Polaristic Automatic Gas Burner

Most simple and reliable automatic burner ever made. No leakage, no sticking, and works perfectly in cold or warm weather. New style burglar alarm spring, a result of long experience in burglar alarm work.

82 BANK ST., WATERBURY, CONN.

WM. T. SMITH,

Manufacturer of Chemically-Pure

BLUE VITRIOL,

For Telephone, Telegraph, Railway Signal, and Fire Alarm Service.

CRYSTALS GRADED IN ANY SIZE DESIRED and in any quantity from 50 lbs. up.

OLD ZINCS and **BATTERY COPPER** and all Copper and Blue Vitriol Deposits bought for cash.

Blackstone Street, corner Culver,

P. O. Box 1325. **PROVIDENCE, R. I.**

PRIMERS OF ELECTRICITY.

Issued during the late International Electrical Exhibition

BY

PROF. E. J. HOUSTON.

25 NUMBERS TO A SET.

An Excellent Work for Students.

ADDRESS,

E. HILTEBRAND,

Franklin Institute, - Philadelphia, Pa.

ИЛЮСТРИРОВАННЫЕ КАТАЛОГИ

EXECUTED IN FIRST CLASS STYLE AND WITH DESPATCH

O.W. MADDAUS

DESIGNER AND ENGRAVER ON WOOD

23 PARK ROW NEW YORK

ANNOUNCEMENT!!

Telephones for Export to

SOUTH AMERICA,

CENTRAL AMERICA

AND

WEST INDIA ISLANDS.

The Tropical American Telephone Co.

LIMITED,

HAS THE **SOLE RIGHT** TO EXPORT

BELL TELEPHONES,

Blake Transmitters, Magneto Call Bells,

and all other patent telephonic instruments, apparatus and supplies, manufactured in the United States, under patents owned or controlled by the

American Bell Telephone Company.

Address only

THE TROPICAL AMERICAN TELEPHONE CO.,

LIMITED,

95 MILK ST., BOSTON, MASS., U. S. A.